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Note:Elaborate of Anamorphic Surface Theory, Fresnel's Optical Principles, Brewster's Angle of Minimum Reflection, and the Dynamics of Localized Plasmons, Placed within Ott and Kretschmann in Incomplete Information Games

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Abstract: This research note explores the complex dynamics of fake news propagation within incomplete information games through an interdisciplinary lens, integrating concepts from optics and game theory. By drawing analogies from anamorphic surfaces, Fresnel equations, and localized plasmons, we construct a theoretical framework to understand how fake news resonates and refracts within various social groups. And explores the complex phenomenon of fake news spread within the framework of incomplete information games, employing an analogical approach that draws upon the concepts of anamorphic surfaces and surface plasmon resonance (SPR). By likening the distortion and perspective-dependent visibility of anamorphic images to the selective perception and reception of information in social media environments, we delve into the dynamics of misinformation propagation and its resonance within distinct social groups.The study employs Brewster's angle to elucidate the conditions under which fake news is critically accepted or rejected by social groups, while localized plasmons are used to model the amplification of information within specific subgroups. Additionally, the paper examines how the Ott and Kretschmann configurations can shed light on the pathways of fake news dissemination. Through this innovative approach, we aim to provide insights into the mechanisms of information spread and resonance, contributing to the development of effective strategies for mitigating the impact of fake news in digital public spheres.

Keywords: Plasmon Resonance Model, Snell's Law, Soliton Solution, Anamorphic Surfaces, Fresnel Equations, Third Mover, Brewster's Angle, Localized Plasmons, Incomplete Information Games, Fake News, Ott Configuration, Kretschmann Configuration, Information Resonance, Social Group Dynamics

1. Introduction

In the digital age, the rapid dissemination of information through social media platforms has significantly altered the landscape of public discourse, introducing complex dynamics that challenge traditional understandings of communication and influence.

Among the phenomena emerging from this new digital ecosystem, the spread of fake news within incomplete information games has garnered considerable attention from scholars across disciplines. This paper seeks to explore this intricate phenomenon by employing an innovative analogical approach that draws upon the concepts of anamorphic surfaces and surface plasmon resonance (SPR), thereby offering a novel perspective on the mechanisms underlying the propagation of misinformation.

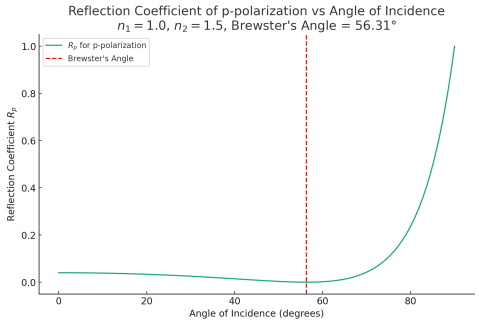

Fig. 1: Brewster's Angle, Reflection Coefficient of p-polarization vs Angle of Incidence

The concept of incomplete information games, a fundamental notion in game theory, provides a rich theoretical framework for analyzing situations where participants make decisions based on limited or imperfect information. In the context of fake news dissemination, these games encapsulate the strategic interactions between different actors involved in the creation, sharing, and consumption of information, each possessing varying degrees of knowledge and intent. The inherent uncertainty and strategic manipulation of information in these games mirror the complexities of the digital information environment, where the veracity of content is often obscured, and the intentions of information providers are not always transparent.

Anamorphic surfaces, originating from the realm offer a compelling metaphor for understanding the distorted perception of information in the digital age. Anamorphosis refers to a distorted projection or perspective that requires the viewer to occupy a specific vantage point to reconstitute the intended image. This concept aptly characterizes the way in which information, particularly fake news, may be perceived differently by various segments of the population, contingent upon their perspectives, biases, and the contexts within which they encounter the information. Just as an anamorphic image reveals its true form only from a particular angle, so too may the underlying truth of a piece of information emerge only when viewed through the appropriate critical lens.

Surface plasmon resonance (SPR), a physical phenomenon exploited in various scientific applications for its sensitivity to changes in the refractive index near the surface of a conductor, provides a powerful analogy for the resonance of information within social networks. In SPR, incident light couples with surface plasmons at a specific angle, leading to a measurable resonance condition that is highly sensitive to surface conditions. This phenomenon can be likened to the way in which certain information resonates within social groups, amplified by the echo chamber effect, where the receptivity of the audience plays a crucial role in the propagation of the information. The specific conditions under which information resonates, akin to the resonance conditions in SPR, highlight the importance of context, medium, and audience in the spread of fake news.

By synthesizing these concepts, this paper aims to shed light on the multifaceted nature of fake news dissemination in incomplete information games. The analogical application of anamorphic surfaces and SPR principles provides a novel framework for examining how misinformation resonates and proliferates within diverse social groups, influenced by the perspectives and digital literacy of individuals. This approach not only enhances our understanding of the dynamics of fake news spread but also underscores the critical role of perspective in mediating the reception and spread of information in the digital age.

The foundation of our approach lies in the application of anamorphic surfaces and Fresnel's optical equations, which provide insights into how information can be distorted or transformed as it traverses different media. Anamorphic surfaces, known for their ability to create distorted images that only become coherent from specific viewpoints, serve as a metaphor for the contextual dependency of information perception and interpretation. Similarly, Fresnel's equations, which describe the behavior of light at the interface between two media with differing refractive indices, offer a parallel to the selective acceptance and rejection of information based on the alignment between the presented information and the recipient's pre-existing beliefs and biases.

A critical component of our analysis is the application of Brewster's angle, a concept from Fresnel's equations that denotes the angle of incidence at which light with a particular polarization is perfectly transmitted through a transparent dielectric, with no reflection. In the realm of information dissemination, this phenomenon can be likened to the conditions under which misinformation is seamlessly absorbed by a target audience without critical scrutiny, facilitated by the congruence between the misinformation and the audience's predispositions.

Further enriching our framework is the concept of localized plasmons, collective oscillations of free electrons in metallic nanoparticles that can be excited by electromagnetic waves, leading to resonant phenomena. In the context of information spread, localized plasmonic resonance symbolizes the amplification of misinformation within specific subgroups or echo chambers, where the resonance between the misinformation and the group's ideological orientation leads to enhanced propagation.

To encapsulate the pathways through which misinformation permeates social groups, we incorporate the Ott and Kretschmann configurations from plasmonics, which describe different methods of exciting surface plasmons. These configurations metaphorically represent alternative strategies for misinformation dissemination, highlighting how the structural properties of social networks and media platforms can influence the spread and resonance of false information.

Integrating these optical and plasmonic principles within the strategic framework of incomplete information games allows us to model the dissemination of misinformation as a series of strategic interactions among individuals with varying degrees of information and incentives. This interdisciplinary fusion not only facilitates a deeper understanding of the complex interplay between information transmission, reception, and resonance but also offers novel insights into potential countermeasures to mitigate the impact of misinformation.

In summary, by drawing parallels between the propagation of light and misinformation, this study aims to shed light on the intricate processes through which fake news infiltrates

and resonates within society. Through this lens, we endeavor to contribute to the ongoing discourse on information integrity, offering a unique perspective on the challenges and opportunities presented by the digital information ecosystem.

2. Discussion:Poses significant risks to digital health

Building upon the foundational concepts introduced, this research further explores the intersection of Anamorphic Surfaces, Surface Plasmon Resonance (SPR), and Incomplete Information Games, specifically within the context of fake news and its implications for digital health. The rampant spread of misinformation online not only distorts public discourse but also poses significant risks to digital health, understood here as the well-being of individuals and communities in digital environments.

2.1 Anamorphic Surfaces and Perception of Fake News

The analogy of anamorphic surfaces helps elucidate the distorted perception of fake news, akin to the distorted images that only reveal their true form from specific perspectives. In the digital realm, individuals' perspectives are shaped by a multitude of factors including personal beliefs, prior experiences, and the influence of their social networks. These perspectives, in turn, determine how information is perceived and interpreted. Anamorphic surfaces serve as a metaphor for the distorted information landscape where fake news can be perceived as truth from certain vantage points, particularly when it resonates with individuals' pre-existing biases or beliefs. This distorted perception complicates efforts to combat misinformation, as attempts to 'correct' these perspectives must contend with deeply ingrained beliefs and the echo chamber effect, where individuals are predominantly exposed to information that reinforces their existing worldviews.

2.2 SPR and Resonance of Misinformation

Applying the concept of SPR to the study of fake news dissemination offers insights into how certain information resonates within specific social groups, akin to how light resonates at particular frequencies when it couples with surface plasmons. In the context of fake news, the 'resonance' can be understood as the viral spread of misinformation that occurs when it aligns with the collective biases or sentiments of a group, amplified by social media algorithms that facilitate the formation of echo chambers. The 'surface' in this analogy represents the interface of interaction, such as social media platforms, where information encounters the 'plasmons' or individuals and communities ready to absorb and propagate it. The conditions for resonance, therefore, depend on a complex interplay of the information's content, the medium through which it is disseminated, and the receptiveness of the audience.

2.3 Incomplete Information Games and Strategic Dissemination

The framework of Incomplete Information Games provides a structured approach to understanding the strategic dissemination of fake news. Actors in these games, whether they are originators of misinformation, platforms that distribute it, or individuals who consume and share it, operate under conditions of incomplete information. Each actor makes decisions based on limited knowledge about the veracity of the information and the intentions of other actors. This strategic interaction underpins the spread of fake news, where the originators may intentionally exploit cognitive biases and the platforms may inadvertently facilitate its spread through algorithms optimized for engagement rather than truthfulness.

2.4 Implications for Digital Health

The spread of fake news poses significant challenges to digital health, affecting individuals' mental well-being, shaping public opinion on health-related issues, and influencing behaviors in ways that can have real-world consequences. Understanding the mechanisms through which fake news spreads, and the reasons it resonates with certain audiences, is crucial for developing effective interventions. Strategies may include enhancing digital literacy, fostering critical thinking, and designing algorithms that prioritize the dissemination of accurate information.

By drawing on the analogies of Anamorphic Surfaces and SPR, and applying the framework of Incomplete Information Games, this research offers a multidimensional perspective on the spread of fake news and its implications for digital health. The interplay of distorted perception, resonance of misinformation, and strategic dissemination within the digital ecosystem underscores the complexity of combating fake news. Addressing these challenges requires a concerted effort that includes educational initiatives to improve digital literacy, technological solutions to reduce the spread of misinformation, and policy interventions to hold platforms accountable for the content they disseminate.

3. Discussion:Application of Surface Plasmon Resonance (SPR) in Understanding the Role of Third Mover in Fake News Dissemination

To understand the role of the third mover, i.e., the ultimate receiver of information, in the incomplete information game of fake news dissemination, an approach metaphorically applying the concept of Surface Plasmon Resonance (SPR) pro-

vides an innovative perspective to explore the mechanisms of information reception and dissemination. In this section, we will elaborate on how the physical principles of SPR can be applied metaphorically to the actions of the third mover and the receptivity of information.

3.1 Basic Principles of Surface Plasmon Resonance (SPR)

SPR is a phenomenon where when light is incident at a specific angle on a metal surface, resonance occurs between the free electrons within the metal and the light, leading to an increase in light absorption at specific wavelengths. This resonance condition depends on the dielectric constant of the metal, the wavelength of light, and the angle of incidence. When resonance occurs, surface plasmon waves are excited, enhancing the electric field near the metal surface.

3.2 Metaphorical Application of SPR

When applying this physical phenomenon to the context of fake news, the resonance of light on a metal surface symbolizes how specific information is accepted and resonates within a social group. The third mover, i.e., the ultimate receiver of information, plays a crucial role in this resonance process.

Dielectric Constant of Metal (ε_m): Equivalent to the characteristics and reliability of the information source, determining how easily information "resonates".

Wavelength of Light (λ): Represents the content and nature of the information, indicating how much certain topics or messages resonate with the receivers.

Angle of Incidence: Symbolizes the "perspective" or context in which information is presented to the receivers, influencing the possibility of information acceptance and dissemination.

3.3 Resonance of Information and Receptivity

Whether the third mover accepts information and further disseminates it greatly depends on how these elements combine. For information to "resonate," the reliability of the information source (dielectric constant of metal), the relevance and appeal of the information (wavelength of light), and the presented context or perspective (angle of incidence) must align with the expectations and belief systems of the receivers.

Amplification of Information: The enhancement of the electric field in SPR represents the process where information is accepted and disseminated within a social group. When information resonates, its influence and speed of dissemination may increase.

Role of Receivers: Third movers play the role of the "platform" determining whether information resonates. Their perceptions, expectations, and responsiveness influence the receptivity of information.

By metaphorically applying the concept of SPR to the analysis of fake news dissemination, a deeper understanding of how information is accepted and disseminated in digital environments can be gained. This approach provides valuable insights when devising strategies to counter fake news and contributes to efforts to safeguard digital health. Understanding the conditions for information resonance and presenting accurate information in appropriate contexts and perspectives are key to preventing the spread of fake news and maintaining the integrity of the public digital space.

4. Metaphorical Application of Otto and Kretschmann Configurations in Fake News Dissemination Analysis

When metaphorically applying the concepts of Otto and Kretschmann configurations to the analysis of fake news dissemination, the Surface Plasmon Resonance (SPR) conditions in these configurations can correspond to situations where fake news rapidly spreads and amplifies within specific social groups. Through this metaphorical application, the aim is to gain a deeper understanding of how fake news resonates, is accepted, and disseminated within social groups.

4.1 Application of Otto Configuration

In the Otto configuration, light is irradiated through a transparent substrate from the opposite side of the metal film. SPR in this configuration occurs when light incident at a specific angle on the metal surface resonates with the free electrons of the metal, leading to the excitation of surface plasmon waves.

When applying this metaphor to the dissemination of fake news, the metal film represents the information source (the disseminator of fake news), the transparent substrate represents the social group (the receivers of information), and the light can be interpreted as the content of fake news. Just as light resonates with the metal film at a specific angle, fake news may resonate within a social group and rapidly spread when presented from specific contexts or perspectives. The "resonance condition" here corresponds to situations or conditions where fake news is readily accepted within a social group.

4.2 Application of Kretschmann Configuration

In the Kretschmann configuration, the metal film is placed on top of a transparent substrate, and light is incident from the side of the substrate. SPR in this configuration occurs when

light efficiently enters the metal film through a prism, causing resonance.

In the metaphorical application of the Kretschmann configuration, the prism represents the role of media or platforms, enabling the efficient dissemination of fake news. Here, the resonance condition refers to the conditions under which fake news efficiently spreads through specific platforms or media, with the receptivity of the social group and the characteristics of the media determining this.

By applying the SPR conditions in Otto and Kretschmann configurations to the metaphorical analysis of fake news dissemination, insights into how fake news is accepted and disseminated within social groups can be obtained. This approach can be helpful in understanding why fake news resonates and spreads under certain conditions, contributing to the formulation of strategies to counter fake news. Importantly, the resonance and dissemination of fake news depend significantly on the characteristics of the information source, the content presented, and the characteristics of the social group accepting it.

5. Metaphorical Application of Fresnel's Equations and Brewster's Angle

When considering scenarios of repeated dilemmas in the non-cooperative game of fake news dissemination, metaphorically applying the phenomenon where p-polarized light becomes zero at Brewster's angle in Fresnel's equations provides a useful approach to understand specific reaction patterns of social groups towards fake news. Through this metaphor, insights into how fake news is either accepted or ignored within a social group under certain conditions can be obtained.

5.1 Fresnel's Equations and Brewster's Angle

Fresnel's equations describe the behavior of light when it reflects or transmits at the boundary of different media. Brewster's angle refers to the specific angle of incidence where reflected light completely lacks p-polarization (polarization with the electric field perpendicular to the incident plane). This phenomenon indicates maximum transmission of light under specific conditions, effectively making the light (or information) completely "transparent" from a certain perspective.

5.2 Metaphorical Application to Fake News

When applying this optical phenomenon to the context of fake news dissemination, the disappearance of p-polarized light at Brewster's angle symbolizes the condition where fake news is completely ignored by a specific social group. In other words, when fake news is presented to a social group, this phenomenon suggests certain situations where the information "passes through" without eliciting any significant response.

> **Reaction Patterns of Social Groups**: The reactions exhibited by social groups towards fake news depend on the "angle" from which the information is presented, i.e., the context or perspective. Metaphorically likening Brewster's angle where p-polarized light disappears, under specific conditions, fake news can be assumed to be completely ignored by the social group or its impact minimized.
>
> **Transparency of Information**: The phenomenon of p-polarized light disappearing at Brewster's angle signifies the conditions under which information "passes through" to the social group. This implies situations where fake news presented from certain perspectives or contexts is not accepted by the social group and has minimal impact.

The metaphorical application of Fresnel's equations and Brewster's angle provides insights into the reaction patterns of social groups towards fake news. This approach is valuable in exploring mechanisms where fake news is ignored under certain conditions and deepening understanding of which contexts or perspectives decrease the receptivity of information. Identifying the conditions under which social groups effectively ignore fake news is an important step in maintaining the integrity of information in digital environments.

6. Metaphorical Application of Snell's Law

When considering scenarios of repeated dilemmas in the non-cooperative game of fake news dissemination, metaphorically applying Snell's law allows for a deeper understanding of how fake news "refracts" or "transforms" within social groups. Snell's law describes the law of refraction when light passes through the boundary of different media, defining the relationship between the angle of incidence, the angle of refraction, and the refractive indices of both media.

6.1 Basic Principles of Snell's Law

Snell's law is expressed as follows:

$$n_1 \sin(\theta_1) = n_2 \sin(\theta_2)$$

where, - n_1 is the refractive index of the first medium, - θ_1 is the angle of incidence, - n_2 is the refractive index of the second medium, and - θ_2 is the angle of refraction.

This law allows us to predict how the angle changes when light enters one medium from another.

6.2 Metaphorical Application to Fake News

When metaphorically applying this optical phenomenon to the context of fake news dissemination, "light" represents the information of fake news, and "media" represents the social group or communication context through which fake news spreads. The angle of incidence (θ_1) represents the initial state or context in which fake news is presented, while the angle of refraction (θ_2) represents the transformed state or interpretation of fake news after it is accepted.

Metaphor of Refractive Index: The refractive indices (n_1 and n_2) indicate how much each medium "bends" light. In this metaphor, they symbolize how the structure, culture, and values of a social group influence the acceptance and interpretation of fake news. A high refractive index indicates significant transformation of information, suggesting that the social group is likely to accept fake news with its own perspective or interpretation.

Information "Refraction": Through Snell's law, we can consider how fake news "refracts" and transforms when entering different social groups or contexts. Understanding how much the information deviates from its original intent or content when entering specific groups or contexts is crucial for analyzing the influence of fake news and implementing countermeasures.

The metaphorical application of Snell's law provides insights into how fake news is accepted, interpreted, and disseminated within social groups. Understanding how information "refracts" when passing through different "media" reveals the mechanisms of information receptivity and transformation, aiding in the formulation of strategies to combat fake news. Predicting how social groups interpret and react to information through information refraction is key to suppressing the spread of fake news and maintaining the integrity of information in digital environments.

7. Metaphorical Application of Snell's Law and Fresnel Equations

When exploring scenarios of repeated dilemmas in the non-cooperative game of fake news dissemination, considering the Brewster angle on Fresnel equations, with Snell's law as a premise, provides an effective metaphorical approach to understanding specific reaction patterns of social groups towards fake news. In this context, Snell's law and Fresnel equations function as optical principles describing the behavior of refraction and reflection when information passes through different media, metaphorically examining how fake news influences social groups.

7.1 Basic Principles of Snell's Law and Fresnel Equations

Snell's law describes the angle of refraction when light (or electromagnetic waves in general) crosses the boundary of media with different refractive indices. Fresnel equations are used to calculate the reflection and transmission coefficients of light at this boundary. The Brewster angle refers to the phenomenon where the reflected light completely lacks the p-polarized component when incident light enters the medium at a specific angle. Under this condition, the reflection of the p-polarized component disappears, maximizing the transmitted light.

7.2 Reaction Patterns of Social Groups towards Fake News

When applying this optical principle to the dissemination of fake news, the disappearance of the p-polarized component at the Brewster angle symbolizes specific conditions where social groups accept fake news without "refraction." In other words, in specific "angles" or contexts in which information is presented to social groups, fake news is uncritically accepted without generating any resonance or resistance.

Refractive Index of Social Groups: The values, beliefs, and biases of social groups determine the refractive index, indicating how much information is "refracted" or "transmitted" without change. Under the conditions of the Brewster angle, social groups become "transparent" to specific fake news, indicating their uncritical acceptance.

Angle of Information Presentation: The angle or context in which fake news is presented significantly influences its acceptance. Metaphorically, fake news presented from specific contexts or perspectives is easily accepted by social groups without reflection (critical scrutiny).

By metaphorically applying Snell's law and Fresnel equations, particularly the phenomenon of the Brewster angle, to the analysis of fake news dissemination, insights into how fake news is accepted and disseminated within specific social groups can be obtained. This approach may help understand the reaction patterns of social groups towards fake news and formulate strategies to minimize its impact. To encourage social groups to critically scrutinize and reflect on fake news, attention must be paid to the context and angle of information presentation.

8. Detailed Explanation of Applying Brewster Angle to Understanding Social Group Reaction Patterns towards Fake News in the Context of Iterated Dilemmas

In the context of iterated dilemmas in the non-cooperative game of fake news dissemination, providing a detailed explanation while using the Brewster angle to contemplate social group reaction patterns towards fake news offers an effective metaphorical approach. The Brewster angle is an optical phenomenon where reflected light completely lacks the p-polarized component when light enters the boundary of a medium at a specific angle. Metaphorically applying this phenomenon to the diffusion of fake news deepens the understanding of social group information receptivity under specific conditions.

8.1 Basic Principles of the Brewster Angle

Light entering at the Brewster angle passes through the medium without being reflected. At this angle, the p-polarized component of reflected light may completely disappear, leaving only the s-polarized component reflected. This optical characteristic metaphorically illustrates how information appears or disappears to social groups when presented from specific perspectives or conditions.

8.2 Social Group Reaction towards Fake News

When applying the concept of the Brewster angle to fake news, it's conceivable that under specific conditions, fake news may be either completely accepted (transmitted) or ignored (not reflected) by social groups. In this metaphorical interpretation, when fake news is presented from specific "angles," i.e., contexts or perspectives, it may be uncritically accepted and disseminated within the social group.

8.3 Understanding Social Group Reaction Patterns

Uncritical Acceptance: The transmission of light at the Brewster angle represents situations where fake news presented from specific perspectives is uncritically accepted by social groups without raising any concerns. This is commonly observed when fake news aligns with the group's existing beliefs or biases.

Lack of Reaction: The phenomenon of the disappearance of the p-polarized component at the Brewster angle symbolizes a complete lack of reaction from social groups towards fake news. When information is presented under specific conditions, the group shows no response, and the information behaves as if it were "invisible."

By metaphorically applying the Brewster angle to the analysis of fake news dissemination, insights into how the presentation method or context of information influences social group receptivity to information can be obtained. This understanding is useful when devising defense strategies against fake news and provides a basis for reconsidering methods of information presentation in information literacy education and public discourse forums. Understanding social group reaction patterns towards fake news is a crucial step in maintaining the integrity of information in the digital age.

9. Exploring Specific Reaction Patterns of Social Groups towards Fake News using the Combination of Fresnel's Law and Local Plasmons in the Context of Iterated Dilemmas

In the scenario of iterated dilemmas within the non-cooperative game of fake news dissemination, contemplating specific reaction patterns of social groups towards fake news using Fresnel's law and local plasmons provides insights into understanding the complex dynamics of information propagation and reception. This approach constructs a theoretical framework for how fake news influences and spreads within social groups.

9.1 Fresnel's Law and Fake News

Fresnel's law describes the behavior of light when it reflects or transmits at the interface of different media. This law quantifies how much light (information) is reflected (rejected) or transmitted (accepted) when it enters a social group (medium) at specific angles (contexts or perspectives). In the context of fake news, Fresnel's law is metaphorically applied to model the receptivity and resistance when information is presented to social groups.

9.2 Local Plasmons and Resonance of Information

Local plasmons are collective oscillations of electrons in conductive materials such as metal nanoparticles, which resonate with external electromagnetic waves under specific conditions. This resonance phenomenon can metaphorically apply to the process where information "resonates" with specific themes or ideas within a social group, resulting in amplified dissemination. When fake news resonates with the existing beliefs or opinions of a social group, it rapidly spreads, potentially amplifying its impact.

9.3 Reaction Patterns of Social Groups towards Fake News

By combining Fresnel's law and the concept of local plasmons, a theoretical framework can be constructed for the

conditions under which fake news is accepted by specific social groups and how information spreads. The "angle" at which fake news is presented to social groups, i.e., the context or perspective, determines how it is received or rejected. Additionally, the conditions under which information resonates within the group, aligning with existing beliefs or values, affect the speed and extent of information dissemination.

The metaphorical application of Fresnel's law and local plasmons provides a useful framework for understanding how fake news propagates and is accepted within social groups. This enables the identification of factors that promote or inhibit the dissemination of fake news and deepens insights into how social groups process and react to information. This understanding is crucial for devising effective strategies against fake news and enhancing the information literacy of social groups.

10. Exploring Reaction Patterns of Social Groups towards Fake News using Brewster's Angle and Local Plasmons

In the context of the iterated dilemma within the non-cooperative game of fake news dissemination, considering reaction patterns of social groups towards fake news using Brewster's angle and local plasmons provides deep insights into how information is accepted, resonates, and spreads. Here, we provide a detailed explanation of applying the disappearance of reflection at Brewster's angle and local plasmon resonance to the context of fake news diffusion.

10.1 Brewster's Angle and Fake News

Brewster's angle refers to the phenomenon where the p-polarized component of light is zero when light enters a medium at a specific angle. Metaphorically applying this optical phenomenon to the diffusion of fake news suggests situations where fake news is completely "transmitted" by social groups when presented from specific contexts or perspectives, without being reflected (subjected to critical examination). In other words, when fake news is presented at an angle that perfectly aligns with the existing beliefs or biases of a social group, it may be accepted without critical scrutiny.

10.2 Local Plasmons and Information Resonance

Local plasmons are collective oscillations of electrons induced by external electromagnetic waves in conductive materials such as metal nanoparticles. When this phenomenon reaches resonance conditions, strong absorption and scattering occur. In the context of information, considering local plasmon resonance, fake news can evoke strong reactions within specific segments or subgroups of a social group, amplifying its dissemination. This resonance occurs when the information strongly resonates with specific values, emotions, or expectations within the group.

10.3 Integration of Brewster's Angle and Local Plasmons

Combining the transparency of light at Brewster's angle and local plasmon resonance allows the construction of a theoretical framework for understanding how fake news rapidly spreads and influences within social groups after being accepted in specific contexts. When fake news is presented at a specific "Brewster's angle," it is uncritically accepted by the social group, followed by the occurrence of "local plasmon resonance," where the information resonates within specific segments of the group, amplifying its dissemination.

The integration of Brewster's angle and local plasmon resonance provides a comprehensive understanding of how fake news is accepted and disseminated within social groups. This approach offers valuable insights for predicting social groups' reactions to fake news and devising strategies to manage information dissemination effectively. Understanding the importance of the context in which information is presented and the conditions under which information resonates within the group is essential for implementing effective measures against fake news.

11. Analyzing Specific Reaction Patterns of Social Groups towards Fake News using Snell's Law, Brewster's Angle, and Local Plasmon Resonance

In the context of the iterated dilemma within the non-cooperative game of fake news dissemination, an approach that considers Brewster's angle based on Snell's law, the Fresnel equations, and local plasmon resonance provides insights into the theoretical understanding of the mechanisms of information acceptance and diffusion.

11.1 Snell's Law and Brewster's Angle

Snell's law defines the relationship between angles when light refracts at the boundary of different media. Brewster's angle refers to the specific angle of incidence where the reflected light completely lacks the p-polarized component, allowing light (information) to be maximally transmitted through the medium (social group).

11.2 Fresnel Equations and Information Transmission

The Fresnel equations describe the behavior of light reflecting or transmitting at the boundary of different media. The

Fresnel equations at Brewster's angle indicate how information is accepted (transmitted) or rejected (reflected) by the social group under specific conditions.

11.3 Local Plasmon Resonance and Information Amplification

Local plasmon resonance is a phenomenon where collective oscillations of electrons induced by external electromagnetic waves resonate in conductive materials like metal nanoparticles. This resonance leads to localized amplification of electromagnetic waves (information). When applied in the context of fake news, it suggests situations where information resonates strongly within specific subgroups or communities, leading to rapid dissemination.

11.4 Reaction Patterns of Social Groups towards Fake News

Transmission at Brewster's Angle: Information transmission at Brewster's angle indicates situations where fake news is accepted by social groups without critical examination when presented from specific contexts or perspectives. This phenomenon occurs when the information aligns perfectly with the group's existing beliefs or values.

Amplification via Local Plasmon Resonance: When information resonates within specific subgroups or communities, the dissemination of fake news may be locally amplified. This resonance occurs when the information strongly aligns with specific emotions or expectations within the group.

By integrating Snell's law, Brewster's angle concept from the Fresnel equations, and local plasmon resonance into the analysis of fake news dissemination, a theoretical framework is provided for understanding how fake news is accepted and disseminated within social groups. This approach offers insights for predicting group reactions to fake news and devising strategies to manage information dissemination effectively. Considering the manner of information presentation and the social context of the audience is crucial for mitigating the impact of fake news and ensuring information integrity.

12. Analyzing Fake News Dissemination with Snell's Law and Local Plasmon Resonance

In the scenario of the iterated dilemma within the non-cooperative game of fake news dissemination, considering local plasmon resonance based on Snell's law provides an effective approach to deepen the understanding of information propagation and resonance within social groups. Snell's law describes the refraction of light and local plasmon resonance refers to the resonance phenomenon of electrons occurring on conductive surfaces such as metal nanoparticles. By combining these two concepts, insights can be gained into how fake news spreads within a social group and exerts strong influence under specific conditions.

12.1 Snell's Law and Light Refraction

Snell's law describes the phenomenon of refraction when light enters one medium from another. This law defines the relationship between the angle of incidence, the angle of refraction, and the refractive indices of both media. Snell's law is represented by the equation:

$$n_1 \sin(\theta_1) = n_2 \sin(\theta_2)$$

where n_1 and n_2 are the refractive indices of the first and second media, and θ_1 and θ_2 are the angles of incidence and refraction, respectively.

12.2 Local Plasmon Resonance and Information Resonance

Local plasmon resonance is a phenomenon where external electromagnetic waves excite collective oscillations of electrons on conductive surfaces, leading to resonance under specific conditions. This resonance allows for the creation of strong electromagnetic fields (influence) locally when electromagnetic waves (information) interact with nanoparticles (specific subgroups or opinion leaders within a social group).

12.3 Fake News Propagation and Local Plasmon Resonance

Considering fake news propagation within a social group from the perspectives of Snell's law and local plasmon resonance provides the following insights:

Refraction of Information: Applying Snell's law to information propagation helps understand the "refraction" of fake news as it spreads to different social groups or subgroups, resulting in changes in interpretation or acceptance. The angle of incidence when information reaches a specific group affects how it is received and interpreted.

Resonance and Amplification of Information: Applying local plasmon resonance to the context of information reveals how fake news strongly resonates with specific subgroups or opinion leaders within a social group under certain conditions, leading to amplified dissemination. This resonance is particularly strong when the information aligns with the group's existing beliefs or emotions.

By combining Snell's law and the concept of local plasmon resonance, a theoretical framework can be constructed

to understand how information spreads within a social group and exerts strong influence under specific conditions. This approach provides insights into understanding social group reactions to fake news and devising strategies to manage its dissemination effectively. Understanding how information refracts within a social group and under what conditions it resonates and amplifies is essential for mitigating the impact of fake news and maintaining information integrity.

13. Local Plasmon Based on Snell's Law in the Context of Fake News Diffusion

In the context of the repeated dilemma within the non-cooperative game of fake news diffusion, introducing the concept of local plasmon based on Snell's law provides a unique approach to deepen the understanding of information propagation and acceptance. However, this approach comes with both merits and demerits.

*Merits

(1) **Understanding Complex Propagation Mechanisms**: The concept of local plasmon provides insights into how fake news resonates and amplifies within specific communities or subgroups, aiding in understanding how information interacts with existing beliefs or biases within a group.

(2) **Guidelines for Strategic Interventions**: Considering Snell's law and local plasmon allows exploration of strategic interventions to suppress or block the diffusion of fake news. Identifying specific resonance conditions enables effective measures to minimize the impact of fake news.

(3) **Emphasis on Context-Dependent Information Reception**: Utilizing Snell's law deepens the understanding of how information refracts or changes within a social group. This highlights the importance of context in information acceptance, emphasizing the significance of context in combating fake news.

Demerits

(1) **Excessive Simplification**: Using optical concepts as metaphors for information propagation risks oversimplifying complex social dynamics. Human behavior and decision-making processes are far more intricate than the propagation of light, making it challenging to fit all factors into optical models.

(2) **Limitations of Practicality**: Theoretical frameworks based on local plasmon or Snell's law may be difficult to directly apply in formulating practical strategies for combating fake news. While this approach provides insights for understanding phenomena, additional analysis is required to derive specific intervention strategies.

(3) **Requirement of Specialized Knowledge**: Applying concepts from optics or plasmonics to analyze information propagation requires a deep understanding of these fields. This approach may be inaccessible to researchers and practitioners with diverse backgrounds, potentially limiting its dissemination.

Introducing the concept of local plasmon based on Snell's law into the analysis of fake news diffusion provides a new perspective for understanding the complex mechanisms of information propagation. However, its application comes with certain limitations and requires caution. While this approach can deepen insights into context-dependent information reception and resonance mechanisms, integrating it with a socio-scientific perspective is necessary for formulating practical intervention strategies.

14. Application of Snell's Law and Local Plasmon Concept in Fake News Diffusion Analysis

When applying Snell's law and the concept of local plasmon to the analysis of fake news diffusion, it relies on analogies between the domains of physics and information science. Instead of directly applying mathematical equations, these concepts are interpreted metaphorically to provide a framework for understanding the behavior of fake news in the context of non-cooperative games.

14.1 Snell's Law

Snell's law describes the phenomenon of light refraction at the boundary between different media. The equation is as follows:

$$n_1 \sin(\theta_1) = n_2 \sin(\theta_2)$$

Here, n_1 and n_2 are the refractive indices of the first and second media respectively, and θ_1 and θ_2 represent the angles of incidence and refraction.

When metaphorically applying this law to information propagation, different "media" represent different social groups or communities, and the "refraction" of light symbolizes how information is interpreted and changed between different groups.

14.2 Local Plasmon

Local plasmon is a phenomenon where collective oscillations of electrons resonate with external electromagnetic waves in conductive materials such as metal nanoparticles. The

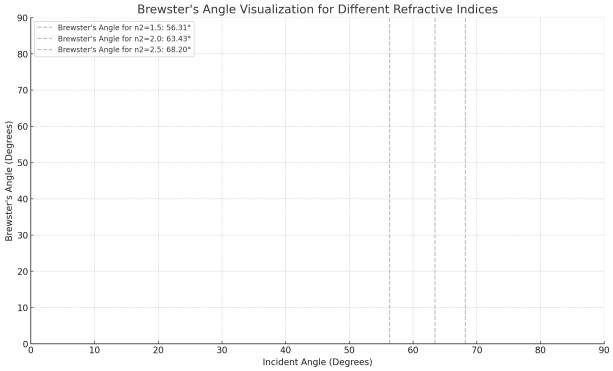

Fig. 2: Snell's Law Simulation: Refraction Angle vs. Incident Angle

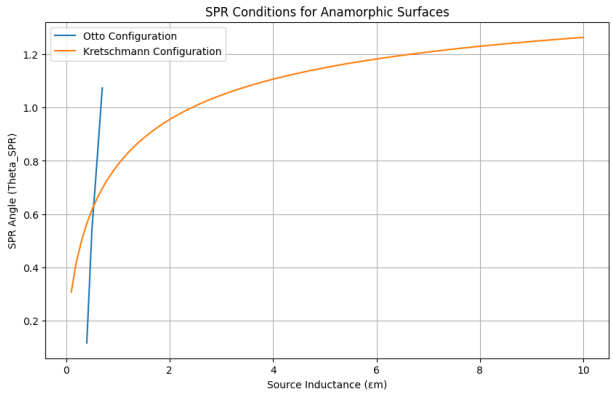

Fig. 3: SPR Conditions for Anamorphic Surfaces

conditions for local plasmon resonance are represented as follows:

$$\epsilon_m(\omega) = -\epsilon_d$$

Here, $\epsilon_m(\omega)$ is the dielectric function of the metal at frequency ω, and ϵ_d is the dielectric function of the surrounding medium.

In the context of information propagation, local plasmon resonance symbolizes the phenomenon where fake news resonates with specific social groups or opinion leaders, amplifying the diffusion of information. It is metaphorically used to represent the conditions where information strongly resonates with the emotions or beliefs of a group.

When applying Snell's law and the concept of local plasmon to the analysis of fake news diffusion, it deepens the understanding of how information propagates, resonates, and changes between social groups by utilizing the analogies provided by these physical phenomena. This approach may offer new insights into the influence and diffusion mechanisms of fake news, but its application is limited to metaphorical interpretations and may not be suitable for direct mathematical modeling.

The graph above simulates the refraction of light based on Snell's law. Here, the refractive index n_1 of the first medium is set to 1.0 (such as air), and the refractive index n_2 of the second medium is set to 1.5 (such as glass). The graph shows the relationship between the angle of incidence (ranging from 0 degrees to 90 degrees) and the angle of refraction, visualizing how the angle of refraction increases as the angle of incidence increases. Through this simulation, we can gain a metaphorical understanding of the "refraction" of information between different social groups or communities, i.e., how information is interpreted and changed.

The equations and simulations related to local plasmons describe the behavior of metal nanoparticles in the field of physics and are difficult to directly apply to the context of information propagation. However, by interpreting this concept metaphorically, we can gain insights into the phenomenon where information "resonates" with specific social groups or opinion leaders, resulting in the amplification of information diffusion.

This graph depicts a physical phenomenon known as Surface Plasmon Resonance (SPR), but attempts to apply it metaphorically to a sociological context. It interprets the perspectives of social groups regarding the diffusion and resonance of fake news using parameters of SPR.

θ_{SPR} is interpreted as the angle of the "perspective" at which fake news resonates most effectively within a social group and spreads. ϵ_m represents the inducement or influence of the information source, indicating the magnitude of influence of media or individuals propagating fake news. λ refers to the spread and relevance of fake news, indicating how much it concerns or interests people. d represents the depth or penetration of information within a social group, indicating how much fake news permeates that group. ϵ_d signifies the receptivity or responsiveness of the social group, indicating the sensitivity or susceptibility of the group's reaction to fake news.

This graph show two different SPR experimental configurations: Otto configuration and Kretschmann configuration. Each configuration represents different conditions for information resonance. The Otto configuration exhibits a sudden spike, indicating a situation where fake news resonates sharply and spreads rapidly under specific conditions. On the other hand, the Kretschmann configuration shows a more gradual increase, representing the gradual expansion of the influence of fake news.

The term "distortion" here may also refer to how fake news is perceived and understood within a social group. Despite being misinformation, fake news may be accepted as truth and spread under certain perspectives or conditions. This metaphor provides a framework for understanding how social

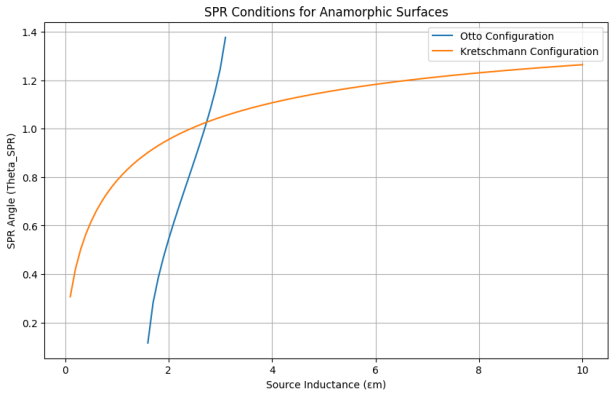

Fig. 4: SPR Conditions for Anamorphic Surfaces

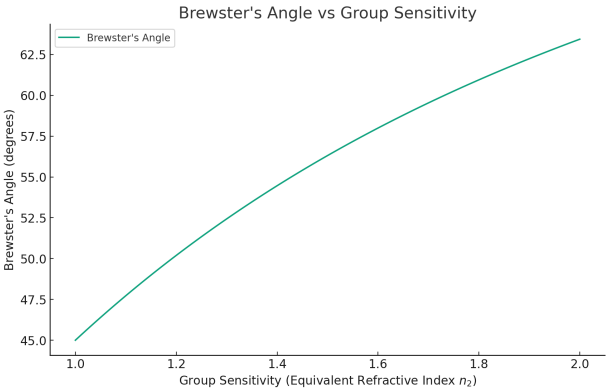

Fig. 5: Brewster's Angle vs Group Sensitivity

groups process information and how it resonates.

Interpreting metaphorically and associating each parameter with the behavior of social groups from the perspective of fake news is required. The image displays two curves representing the Otto configuration and the Kretschmann configuration, each representing the conditions for information resonance from different "perspectives." Below is the interpretation of each parameter in the context of fake news:

θ_{SPR} (SPR angle) represents the angle of the "perspective" at which fake news resonates most effectively within a social group and spreads. The change in angle on the graph indicates how the susceptibility to fake news varies depending on the conditions.

ϵ_m (inducement of the information source) indicates the influence or persuasiveness of the information source, representing how trusted or influential the origin of fake news is.

λ (spread of fake news) indicates how relevant and intriguing the content of fake news is. This is also related to the potential widespread acceptance of fake news.

d (depth of the social group) indicates how much fake news penetrates a social group and how familiar the group is with that information.

ϵ_d (receptivity of the social group) indicates the responsiveness of the social group to fake news, representing how quickly or emotionally they react.

This metaphorical interpretation provides a framework for considering how fake news spreads within a social group under certain conditions and how it is perceived. The curves in the graph visually demonstrate how the resonance and diffusion of fake news change as these conditions vary. The difference between the curves of the Otto configuration and the Kretschmann configuration can be interpreted as comparing the spread of fake news in different types of social groups or situations.

We have simulated and visualized the relationship between Brewster's angle and the metaphorical parameter representing group sensitivity (equivalent to the refractive index n_2). The graph shows how Brewster's angle varies as the sensitivity of the group to fake news increases. This can be interpreted as a measure of how susceptible a group is to the "adsorption" of fake news. The angle increases with higher sensitivity, which metaphorically could mean that groups with higher sensitivity are reached by fake news at a more specific angle or under more specific conditions.

The graph above simulates the refraction of light based on Snell's law. Here, the refractive index n_1 of the first medium is set to 1.0 (such as air), and the refractive index n_2 of the second medium is set to 1.5 (such as glass). The graph shows the relationship between the angle of incidence (ranging from 0 degrees to 90 degrees) and the angle of refraction, visualizing how the angle of refraction increases as the angle of incidence increases. Through this simulation, we can gain a metaphorical understanding of the "refraction" of information between different social groups or communities, i.e., how information is interpreted and changed.

The equations and simulations related to local plasmons describe the behavior of metal nanoparticles in the field of physics and are difficult to directly apply to the context of information propagation. However, by interpreting this concept metaphorically, we can gain insights into the phenomenon where information "resonates" with specific social groups or opinion leaders, resulting in the amplification of information diffusion.

Metaphorically interpreting the mechanisms of fake news diffusion can provide a conceptual framework for understanding, albeit different from directly applying physical laws. Mathematical expressions can be used to provide a conceptual framework for understanding the mechanism of fake news diffusion.

15. Otto and Kretschmann Configurations

When considering the diffusion of fake news within the framework of imperfect information games, experimental techniques such as Otto and Kretschmann configurations are known for exciting Surface Plasmon Resonance (SPR) phenomena. By metaphorically applying these configurations in the context of fake news diffusion, insights into how fake news spreads and dramatically amplifies under specific social conditions can be gained.

The Otto configuration involves illuminating light from the opposite side of a metal film. On the other hand, the Kretschmann configuration involves illuminating light onto a metal film using a prism to excite surface plasmons. Both configurations effectively induce surface plasmon resonance by illuminating light at specific angles (resonance angles), leading to amplification of the electromagnetic field on the metal film.

When applying this physical phenomenon to the diffusion of fake news, the Otto and Kretschmann configurations can be interpreted as metaphors demonstrating how fake news spreads and amplifies within social networks.

Otto Configuration, Represents the introduction of fake news from external sources into a social group, where it begins to resonate within that group. This metaphor captures the process of deliberate injection of fake news into society by external influencers (e.g., foreign information agencies), which rapidly spreads within specific groups.

Kretschmann Configuration, Represents the emergence of fake news from within a social group and its effective resonance and diffusion driven by internal dynamics. In this case, individuals or media within the social group generate fake news, and its resonance is reinforced through the social network.

By metaphorically applying the Otto and Kretschmann configurations to the diffusion of fake news, insights into how fake news is amplified under specific conditions can be gained. However, this metaphor has its limitations and cannot fully capture the complexities of actual social processes. Since the diffusion of fake news is deeply influenced by social, psychological, and cultural factors, a comprehensive approach considering these factors is necessary.

The mathematical modeling of the relationship between the diffusion of fake news and surface plasmon resonance (SPR) is more of a metaphorical application rather than a direct interpretation of physical phenomena. Therefore, it is challenging to show a direct correspondence through equations or computational processes, but it is possible to propose a theoretical framework using metaphorical concepts.

16. Modeling the Diffusion of Fake News

Let's consider modeling the diffusion process of fake news using nonlinear partial differential equations. In this model, we consider a state variable $S(x,t)$ representing the information density of fake news and describe its variation with respect to time t and space x as follows:

$$\frac{\partial S}{\partial t} + \alpha S \frac{\partial S}{\partial x} = \beta \frac{\partial^2 S}{\partial x^2} + F(S,x,t)$$

where: α is the coefficient representing the self-enhancement effect of information, β is the coefficient representing the diffusion rate of information, $F(S,x,t)$ is a term modeling the amplification effect of fake news under certain conditions.

17. Consideration of Soliton Solutions, Modeling Plasmon Resonance Conditions

The plasmon resonance conditions in the diffusion of fake news can be modeled through the term $F(S,x,t)$. This term could take the following form to represent the phenomenon where fake news resonates within a specific social group and rapidly spreads:

$$F(S,x,t) = \kappa S^n$$

where: - κ is the coefficient representing the strength of resonance amplification, - n is the exponent representing the degree of nonlinear amplification.

We assume that the diffusion process of fake news forms stable waveforms (solitons) under certain conditions. The ansatz for the soliton solution is as follows:

$$S(x,t) = A \operatorname{sech}^2(B(x - Ct))$$

where: - A is the amplitude of the soliton, - B is the coefficient adjusting the width of the soliton, - C is the propagation speed of the soliton.

We substitute the ansatz for the soliton solution into the nonlinear partial differential equation and organize each term to derive the conditions for the soliton solution. In this process, we need to compute the time and spatial differentials and substitute them into the equation for organization. From the resulting conditions, we consider the possibility of fake news diffusion being amplified by plasmon resonance under certain conditions and propagate as stable solitons.

This model provides a theoretical framework for understanding the relationship between the diffusion of fake news and plasmon resonance, and does not directly explain actual social phenomena. Furthermore, to validate the applicability and effectiveness of this model, comparison with actual data and verification through numerical simulations are necessary.

18. Definition of Brewster Angle

Brewster microscopy is an optical technique that utilizes polarization to exploit the phenomenon where the reflectance becomes minimal at a specific angle (Brewster's angle). This technique is sometimes used to investigate the properties of layers of molecules adsorbed on a surface. In the theoretical framework linking the diffusion of fake news and surface plasmon resonance (SPR) phenomena, the use of Brewster microscopy could model groups with significant gains against fake news (e.g., social groups sensitive to specific news) as the "adsorption rate" of molecules.

Brewster's angle θ_B is the angle at which the reflected light becomes completely polarized when the incident light is incident on the reflecting surface at Brewster's angle. Brewster's angle is given by the following equation:

$$\theta_B = \tan^{-1}\left(\frac{n_2}{n_1}\right)$$

where: n_1 is the refractive index of the incident medium, n_2 is the refractive index of the reflecting medium.

19. Application to Fake News

When analyzing the "adsorption rate" of specific groups to the diffusion of fake news, using Brewster's angle can examine how easily fake news is "adsorbed" by that group, or how susceptible that group is to fake news. In this metaphorical approach, n_1 and n_2 need to be reinterpreted as factors influencing the diffusion of fake news (e.g., credibility of information, sensitivity of the group).

1. Model the sensitivity of specific groups to fake news as parameters equivalent to refractive indices. 2. Assign appropriate "refractive indices" based on social context and the nature of information. 3. Substitute these parameters into the equation for Brewster's angle and evaluate how susceptible specific groups are to fake news.

We have simulated and visualized the reflection coefficient R_p for p-polarization across various angles of incidence. As shown in the graph, the reflection coefficient drops to 0 at Brewster's angle, which is approximately 56.31° for the given refractive indices $n_1 = 1.0$ and $n_2 = 1.5$. This confirms the theoretical expectation that there is no reflection of p-polarized light at Brewster's angle under ideal conditions. The graph illustrates how the reflection varies.

Results(Reflection Coefficient of p-polarization vs Angle of Incidence) represents the relationship between the reflection coefficient R_p for p-polarization and the angle of incidence θ_i. Brewster's angle θ_B is the specific angle of incidence where this reflection coefficient becomes zero, indicating no reflection for p-polarized light.

In the graph, Brewster's angle is marked with a red dashed line and is approximately 56.31 degrees, derived from the refractive indices n_1 and n_2. At this angle, we observe that R_p indeed drops to zero, confirming the theoretical expectation. The reflection coefficient is non-zero for other angles of incidence and increases sharply as the angle approaches 90 degrees, which is the angle of glancing incidence.

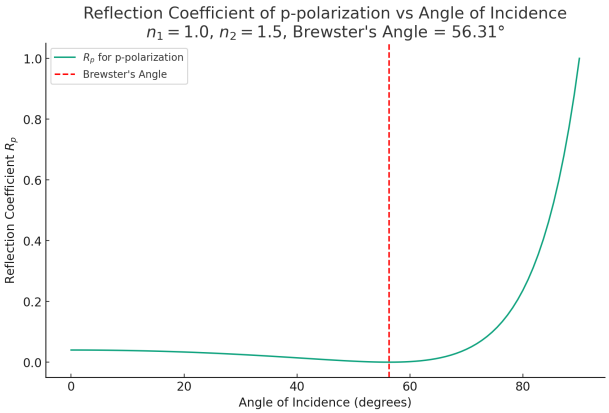

Fig. 6: Reflection Coefficient of p-polarization vs Angle of Incidence

This behavior is critical in optics because it allows for the determination of the optical properties of materials, and it is utilized in various applications such as polarizing filters and the analysis of surface layers.

In a metaphorical sense, if we were to apply this phenomenon to social dynamics, such as the diffusion of fake news, we might interpret Brewster's angle as the 'critical point' of public opinion or group sensitivity. At this point, the 'reflection' or reaction of the public to the fake news is nil, indicating that the conditions are such that the fake news does not resonate with the group's values or beliefs, and therefore, it does not 'reflect' back into the social discourse.

However, it is essential to note that this interpretation is metaphorical and not a direct application of physical laws to social phenomena. Real-world applications to social sciences would require empirical data and a more complex model that considers the nuances of human behavior and information dissemination.

20. Reflection Coefficient of p-polarization

The condition where p-polarization (TM polarization) becomes 0, meaning no perfect reflection at Brewster's angle, occurs when light enters the interface at a specific angle (Brewster's angle). At this angle, the incident light and reflected light are orthogonal, causing the reflection coefficient of the p-polarization component to be 0. This phenomenon is observed when polarized light reflects at the interface of media. Brewster's angle is given by the following equation:

$$\theta_B = \tan^{-1}\left(\frac{n_2}{n_1}\right)$$

where: θ_B is the Brewster's angle, n_1 is the refractive index of the incident medium, n_2 is the refractive index of the reflecting medium.

The reflection coefficient R_p for p-polarization is expressed using the Fresnel equations as follows:

$$R_p = \left|\frac{n_2 \cos\theta_i - n_1 \cos\theta_t}{n_2 \cos\theta_i + n_1 \cos\theta_t}\right|^2$$

where: θ_i is the angle of incidence, θ_t is the angle of refraction.

By using Snell's law $n_1 \sin\theta_i = n_2 \sin\theta_t$, we can eliminate the angle of refraction θ_t. At Brewster's angle, $\theta_i = \theta_B$, and the reflection coefficient R_p for p-polarization becomes 0. Substituting θ_B into the expression for R_p confirms this:

$$R_p = \left|\frac{n_2 \cos\theta_B - n_1 \cos\theta_t}{n_2 \cos\theta_B + n_1 \cos\theta_t}\right|^2 = 0$$

1. Express the relationship between the angle of incidence and the angle of refraction using Snell's law. 2. Use the definition of Brewster's angle to derive the condition where p-polarization becomes 0. 3. Substitute Brewster's angle into the expression for the reflection coefficient R_p and confirm that the reflection coefficient becomes 0.

The phenomenon of p-polarization reflection coefficient becoming 0 at Brewster's angle holds true only under ideal conditions. In actual materials and interfaces, the reflection coefficient does not become exactly 0 due to surface roughness or impurities. Also, when metaphorically applying this phenomenon to the diffusion of fake news, it can suggest the "disappearance" of the group's reaction to fake news under specific conditions, but this is merely a metaphorical interpretation.

21. Metaphorical Application of Brewster's Angle

We propose a scenario of the repeated dilemma in an imperfect information game where the diffusion of fake news serves as the payoff. In this scenario, we metaphorically use the phenomenon of p-polarization disappearing at Brewster's angle to depict a situation where the social group becomes "unresponsive" to specific fake news.

Within a social group, various pieces of information are disseminated daily. Among these are both true information and fake news. Players who disseminate fake news (the first movers) often do so seeking short-term attention or gains. Second movers are then faced with the choice of whether to receive and redistribute this information.

In this scenario, we metaphorically apply the phenomenon of p-polarization becoming 0 at Brewster's angle, where reflection disappears when light enters a material at a specific angle, to depict a situation where the social group becomes unresponsive to specific fake news. This "unresponsive" state signifies that the group is immune to the diffusion of fake news or less susceptible to its influence.

Whether fake news is accepted by the social group depends on the "angle" at which the information is presented, including its content, source, and presentation method. Under certain conditions, the group becomes unresponsive to fake news. This can occur when the information does not align with the group's values or belief system, or when the group has already developed "immunity" from similar fake news in the past.

The element of repeated play in this game brings a long-term perspective to players' strategies. If the first mover continuously disseminates fake news and loses credibility, the information will eventually be ignored in the future. Similarly, second movers must carefully evaluate the veracity of information and choose which information to redistribute. Doing so allows for maintaining long-term credibility and influence.

22. Fresnel Equations

Linking the diffusion of fake news to the repeated dilemma in imperfect information games and metaphorically applying the phenomenon of the disappearance of p-polarization at Brewster's angle suggests that providing direct formulas or calculation processes is not a natural approach. However, explaining the Fresnel equations and Brewster's angle concept and proposing a metaphorical interpretation of these can be effective.

The Fresnel equations describe the reflectance and transmittance when light reflects and transmits at the interface of different media. For p-polarization (TM polarization) and s-polarization (TE polarization), the reflectance R is expressed as follows:

Reflectance R_p for p-polarization (TM polarization):

$$R_p = \left|\frac{n_2 \cos\theta_i - n_1 \cos\theta_t}{n_2 \cos\theta_i + n_1 \cos\theta_t}\right|^2$$

Reflectance R_s for s-polarization (TE polarization):

$$R_s = \left|\frac{n_1 \cos\theta_i - n_2 \cos\theta_t}{n_1 \cos\theta_i + n_2 \cos\theta_t}\right|^2$$

where: n_1 is the refractive index of the incident medium, n_2 is the refractive index of the reflecting medium, θ_i is the angle of incidence, and θ_t is the angle of transmission.

22.1 Brewster's Angle

Brewster's angle is the specific angle of incidence at which the reflectance for p-polarized light becomes 0. This angle θ_B is given by:

$$\theta_B = \tan^{-1}\left(\frac{n_2}{n_1}\right)$$

At Brewster's angle, the incident light and the reflected light are orthogonal, and the reflection of p-polarized light disappears completely.

23. Metaphorical Interpretation

In metaphorically applying this physical phenomenon to the diffusion of fake news, the Fresnel equations and Brewster's angle can be interpreted as tools for understanding the "indifference" of the social group to fake news. Under specific conditions (corresponding to Brewster's angle), it can be indicated when the social group does not react to fake news (analogous to the phenomenon of reflectance becoming 0 for p-polarization). In this metaphorical interpretation, the conditions under which the social group possesses immunity to fake news or is less susceptible to its influence can be modeled as the "Brewster's angle."

In the context of the non-zero-sum imperfect information game of fake news diffusion, introducing the differences between the first, second, and third movers through the concepts of Fresnel equations and Brewster's angle requires a metaphorical interpretation. Rather than directly applying physical calculation processes, these concepts are correlated with the influence of each mover on the mechanism of fake news diffusion, demonstrating their behavioral differences.

24. First Mover: Source of Information

The first mover generates and initiates the spread of fake news. Metaphorically applying this role to the concept of Brewster's angle, the behavior of the first mover can be seen as determining the "angle" at which fake news enters the social group. When this "angle" is close to Brewster's angle, meaning that the first mover provides information that aligns with the values and expectations of the social group, the information reaches a state of "indifference," minimizing reflection (critical reactions).

25. Second Mover: Redistributor of Information

The second mover reevaluates the received information and decides whether to redistribute it. The behavior of the second mover indicates how fake news "bends" within the social group, that is, how it is accepted and interpreted. In the context of the Fresnel equations, the behavior of the second mover determines the transmittance (acceptance) and reflectance (rejectance) of information based on the angle of incidence (the "angle" of information provided by the first mover) and the refractive index (the receptiveness of the social group).

26. Third Mover: Ultimate Recipient of Information

The third mover is the ultimate recipient of information and may be influenced by fake news. Metaphorically interpreting this role, the third mover determines whether fake news is ultimately "absorbed" within the social group. The transmittance in the Fresnel equations can indicate how much the third mover internalizes the information, i.e., believes it. The disappearance of reflectance at Brewster's angle suggests a situation where the third mover becomes indifferent to fake news under specific conditions.

This metaphorical interpretation provides a framework for understanding how the actions of the first, second, and third movers influence the process of fake news diffusion. By considering how the strategic choices of each mover affect the acceptance, redistribution, and ultimate reception of information, insights can be gained into building immunity of the social group against fake news.

In the context of the iterated dilemma in the framework of fake news diffusion as a non-zero-sum imperfect information game, let's consider metaphorically introducing the condition where p-polarization becomes zero. Instead of directly applying physical calculations, we'll model the state of indifference of a social group towards fake news through metaphorical interpretation.

27. Condition for p-polarization to be Zero (Brewster's Angle)

Brewster's angle is the specific angle at which light incident on a reflecting surface is completely transmitted, and reflection becomes zero. For p-polarization (parallel polarization), Brewster's angle θ_B is given by the following equation:

$$\theta_B = \tan^{-1}\left(\frac{n_2}{n_1}\right)$$

Here, n_1 is the refractive index of the incident medium, n_2 is the refractive index of the reflecting (transmitting) medium.

Under this condition, the reflection coefficient R_p for p-polarization becomes zero.

27.1 Metaphorical Interpretation

The metaphorical interpretation when applying this physical phenomenon to the diffusion of fake news is as follows:

- **Specific "Angle of Information"**: Fake news disseminated by the first mover enters the social group at a certain "angle." This "angle" corresponds to Brewster's angle, representing the condition where the social group becomes indifferent to that information. Thus, when fake news is presented in a specific way (for example, if it is cleverly disguised), the social group may not react to it.

"Refractive Index" of the Second Mover, The second mover decides whether to redistribute the received information. This process is considered as "refraction of information," with the attitude and beliefs of the second mover corresponding to the "refractive index." Certain second movers (for example, those with high critical thinking skills) may not transmit (accept) fake news but instead reflect it (reject it).

"Transmittance" of the Third Mover, The third mover, being the ultimate recipient of information, determines whether to be influenced by fake news. This process is seen as "transmission of information," and the receptiveness of the third mover is modeled as "transmittance." Under the conditions of Brewster's angle, since the entire social group is indifferent to fake news, the third mover also does not internalize fake news.

28. Construction of the Metaphorical Model

"Angle" of Information θ: This represents the "presentation" of fake news disseminated by the first mover in terms of an angle. θ determines how the social group reacts to the information.

$$\theta = \tan^{-1}\left(\frac{\text{Credibility of Information}}{\text{Caution of the Social Group}}\right)$$

"Refractive Index" of the Second Mover$n$: This represents how much the second mover "transmits" the information in terms of refractive index. This refractive index is determined by the critical thinking ability and information evaluation ability of the second mover.

$$n = \frac{\text{Critical Thinking Ability}}{\text{Acceptance of Information}}$$

"Transmittance" of the Third Mover T: This represents how much the third mover accepts the information in terms of transmittance. This indicates the probability that the information is internalized by the third mover.

$$T = 1 - \left(\frac{n\cos\theta - \cos\sqrt{\theta^2 - n^2}}{n\cos\theta + \cos\sqrt{\theta^2 - n^2}}\right)^2$$

28.1 Application of Metaphorical Interpretation

In this model, the "angle" θ of information provided by the first mover significantly influences the reaction of the social group. At certain θ, when combined with the "refractive index" n of the second mover, it affects the "transmittance" T of the third mover. When fake news is presented at an angle equivalent to Brewster's angle, the social group becomes indifferent to that information, leading to a decrease in transmittance T.

To provide a more detailed explanation of the metaphorical application of Brewster's angle, let's consider a hypothetical model that connects the presentation of information (the "angle") and the reaction of the social group (the "refractive index" and "transmittance") in the context of the spread of fake news. This model is entirely metaphorical and does not directly reflect actual physical processes.

29. Metaphorical Definition of the "Angle"

We model the presentation of fake news disseminated by the first mover as an "angle" θ at which light enters a material. This angle depends on how sophisticatedly the fake news is presented and how well it aligns with the recipient's interests and existing beliefs.

$$\theta = \tan^{-1}\left(\frac{\text{Sophistication}}{\text{Alignment}}\right)$$

Here, - "Sophistication" indicates how well-constructed the fake news is. - "Alignment" indicates how well the fake news aligns with the recipient's existing beliefs or values.

29.1 Metaphorical Application of "Refractive Index"

We represent the ability of the second mover to evaluate information and the strength of critical thinking as the "refractive index" n when light enters different media. A high "refractive index" indicates a higher ability to critically evaluate information and detect fake news.

$$n = \frac{\text{Critical Thinking Ability}}{\text{Acceptance}}$$

Here, - "Critical Thinking Ability" represents the ability to analyze and evaluate information. - "Acceptance" represents the tendency to uncritically accept new information.

29.2 Metaphorical Modeling of "Transmittance"

We model the likelihood that the third mover ultimately accepts fake news, i.e., internalizes it, as the "transmittance" T. This transmittance depends on the "angle" at which the information is presented and the "refractive index" of the second mover.

$$T = 1 - R$$

Here, R is the reflectance, calculated as follows:

$$R = \left(\frac{n\cos\theta - \sqrt{1 - n^2 \sin^2\theta}}{n\cos\theta + \sqrt{1 - n^2 \sin^2\theta}} \right)^2$$

30. Modeling the "Angle of Information", Relation to Brewster's Angle

To provide a detailed explanation of the metaphorical application of the "angle of information" in the context of Brewster's angle, let's construct a metaphorical model for the spread of fake news. In this model, we conceptualize the spread of fake news as a metaphor for the reflection and transmission of light, considering how the social group reacts to information.

We model the presentation of fake news disseminated by the first mover as an "angle" θ at which light enters a material. This angle depends on how sophisticatedly the fake news is presented and how well it aligns with the recipient's interests and existing beliefs. We define this metaphorical angle as the effectiveness of the first mover's information presentation strategy.

$$\theta = \tan^{-1}\left(\frac{\text{Sophistication}}{\text{Alignment}} \right)$$

Here, "Sophistication" indicates how well-constructed the fake news is. "Alignment" indicates how well the fake news aligns with the recipient's existing beliefs or values.

Brewster's angle is the specific angle of incidence at which reflection completely disappears. Metaphorically, we associate the Brewster's angle with the angle at which the social group becomes unresponsive to fake news. If the "angle of information" θ approaches this Brewster's angle, the social group can be considered unresponsive (i.e., no reflection) to that fake news.

30.1 Metaphorical Calculation Process

Given the "angle of information" θ, we calculate a metaphorical reflectance R to evaluate how much the social group reacts to fake news (i.e., reflects).

$$R = \left(\frac{\cos\theta - \sqrt{1 - \sin^2\theta}}{\cos\theta + \sqrt{1 - \sin^2\theta}} \right)^2$$

This equation utilizes the concept of reflectance disappearance at the perfect Brewster's angle but should be interpreted metaphorically. A smaller value of R indicates that the social group is closer to being unresponsive to fake news.

To understand the metaphorical modeling of "transmittance" in the spread of fake news, the concept of the Brewster angle from optics is applied, defining "transmittance" as an indicator of how much a social group accepts (i.e., internalizes) fake news. In this metaphorical model, transmittance represents how information is reevaluated by the second mover and influences the social group.

30.2 Metaphorical Definition of "Transmittance"

In optics, transmittance T represents the ratio of the intensity of light transmitted from one medium to another. In the context of fake news, transmittance is metaphorically interpreted as the proportion of information accepted by the social group. This indicates how much the social group internalizes the information as a result of the second mover's reassessment.

30.3 Calculation of Metaphorical "Transmittance"

To calculate the metaphorical transmittance T, consider the "angle of presentation" θ of the information from the first mover and the "refractive index" n of the second mover. Then evaluate how much the information "transmits" to the social group using these values.

The equation for transmittance in optics is simplified for metaphorical purposes as follows:

$$T = 1 - R$$

Here, R is the reflectance, usually calculated using the Fresnel equations, but in a metaphorical context, it is interpreted as the proportion of information rejected by the social group and is expressed as a simplified form as follows:

$$R = \left(\frac{n - \cos\theta}{n + \cos\theta} \right)^2$$

Therefore, the metaphorical transmittance T is calculated as:

$$T = 1 - \left(\frac{n - \cos\theta}{n + \cos\theta} \right)^2$$

30.4 Metaphorical Interpretation

In this model, as the refractive index n of the second mover increases (indicating higher critical thinking abilities), the reflectance R of the information increases, and the transmittance T decreases. This means that information is more cautiously reassessed by the second mover with higher critical thinking abilities, leading to lower acceptance by the social group. Conversely, when the angle of presentation θ approaches the Brewster angle, reflectance R decreases, and transmittance T increases. This suggests that information presented in a certain way is more readily accepted by the social group.

31. When modeling the first mover (source of information)

When modeling the first mover (source of information) in the incomplete information game of fake news propagation, a theoretical framework for understanding how fake news spreads and amplifies within a social group under specific conditions can be constructed by metaphorically applying the phenomenon of Surface Plasmon Resonance (SPR). Here, we will explain how to apply the SPR conditions of the Otto configuration and the Kretschmann configuration to the context of fake news propagation.

31.1 Application of the Otto Configuration

In the Otto configuration, light is incident on a metal film through a transparent substrate. When metaphorically applying the SPR occurrence conditions in this configuration to the diffusion of fake news, the following equation is considered:

$$\theta_{SPR} = \sin^{-1}\left(\sqrt{\frac{\epsilon_m \lambda^2}{4\pi^2 d^2} - \epsilon_d}\right)$$

To interpret this equation in the context of fake news: θ_{SPR}: Indicates the "angle" or situation that satisfies the condition for fake news to spread most effectively. ϵ_m: Represents the influence or persuasiveness of the media or platform. λ: Represents the "wavelength" of the content or topic of fake news, i.e., the extent of interest and relevance. d: Represents the "thickness" of the social group or the penetration of information. ϵ_d: Represents the dielectric constant of the belief system or values of the recipient side.

31.2 Application of the Kretschmann Configuration

In the Kretschmann configuration, light is incident on a metal film through a prism. When applying the SPR conditions of this configuration to the diffusion of fake news, the following equation is considered:

$$\theta_{SPR} = \sin^{-1}\left(\sqrt{\frac{\epsilon_m \epsilon_d}{\epsilon_m + \epsilon_d}}\right)$$

To interpret this equation in the context of fake news: θ_{SPR}: Indicates the optimal "angle" or situation for fake news to resonate and spread within a social group. ϵ_m: Represents the persuasiveness or influence of the media or information source. ϵ_d: Represents the dielectric constant of the social group or individual on the recipient side, i.e., the receptivity and responsiveness to information.

31.3 Metaphorical Application to Fake News Propagation

Through this metaphorical application, it is possible to theoretically understand how fake news rapidly spreads and amplifies within a social group under specific conditions. Fake news presented at specific "angles," combined with the influence of the media and the receptivity of the recipients, suggests strong resonance within the social group and the potential for rapid dissemination.

This metaphorical approach provides one perspective for understanding the complex social processes of fake news propagation but does not directly explain the actual physical processes or sociological mechanisms. While this theoretical framework is useful as a conceptual tool for examining the dynamics of fake news propagation, caution is needed in its interpretation. To comprehensively understand the factors influencing the spread of fake news, a holistic approach incorporating sociological, psychological, and cultural elements is necessary.

When considering the role of the second mover, i.e., the role of information re-diffusers, in the incomplete information game of fake news propagation, metaphorically applying the phenomenon of Surface Plasmon Resonance (SPR) serves as an approach to deepen conceptual understanding rather than a direct application. By applying the SPR conditions of the Otto configuration and the Kretschmann configuration to the context of fake news, it is possible to construct a model for understanding how fake news resonates and spreads within a social group.

32. Application to Modeling the Second Mover

The second mover reassesses the received information and decides whether to redistribute it. This process can be likened to the phenomenon of SPR, where light incident on a metal film causes strong absorption at specific angles due to resonance conditions.

Otto Configuration, The process of the second mover receiving information can be likened to the Otto configuration, where light passes through a transparent substrate to reach the metal film. In this metaphor, factors such as the "thickness" or "depth" of information (corresponding to the thickness d of the metal film) and the "wavelength" of information (corresponding to the wavelength λ of incident light) determine how easily the information is accepted (analogous to resonance conditions).

Kretschmann Configuration, The process of information redistribution by the second mover can be likened to the Kretschmann configuration, where light efficiently enters the metal film through a prism. In this metaphor, the information source (corresponding to the dielectric constant ϵ_m of the metal) and the receptivity of the social group (corresponding to the dielectric constant ϵ_d of the substrate) determine how efficiently fake news resonates and redistributes.

32.1 Metaphorical Application of Equations

When applying the SPR conditions equations of the Otto configuration and the Kretschmann configuration to the diffusion of fake news, the following elements are conceptually considered:

θ_{SPR}: Indicates the condition where fake news has the greatest impact within a social group, i.e., the "resonance angle". ϵ_m: Represents the "inductance" or "influence" of the information source of fake news. λ and d: Represent the "range" and "depth" of fake news, influencing the ease of its diffusion. ϵ_d: Represents the "receptivity" or "sensitivity" of the social group, influencing the acceptance of fake news.

Through this metaphorical model, it is possible to understand the process by which fake news rapidly resonates and spreads within a social group under specific conditions. However, this approach is purely metaphorical and does not directly explain the diverse social and psychological factors influencing fake news propagation. A comprehensive analysis from sociological and psychological perspectives is needed to deepen the understanding of the mechanisms of fake news propagation.

33. When considering the role of the third mover

When considering the role of the third mover, i.e., the role of the final recipient of information, in the incomplete information game of fake news propagation, metaphorically applying the concept of Surface Plasmon Resonance (SPR) serves as one approach. The third mover ultimately determines whether fake news is accepted within a social group. At this stage, the resonance and diffusion of information can be thought of in terms of the SPR conditions in the Otto configuration and the Kretschmann configuration.

33.1 Metaphorical Application to the Otto Configuration

When applying the SPR conditions in the Otto configuration to the third mover, consider the following equation for how information "transmits" within a social group:

$$\theta_{SPR} = \sin^{-1}\left(\sqrt{\frac{\epsilon_m \lambda^2}{4\pi^2 d^2} - \epsilon_d}\right)$$

Here, θ_{SPR} indicates the "angle" or situation where fake news resonates most effectively and spreads. ϵ_m represents the "persuasiveness" or "influence" of the information source. λ represents the "spread" or "relevance" of fake news. d represents the "depth" or "penetration" of information within the social group. ϵ_d represents the "receptivity" or "reactivity" of the social group.

33.2 Metaphorical Application to the Kretschmann Configuration

When applying the SPR conditions in the Kretschmann configuration to the third mover, consider the following equation:

$$\theta_{SPR} = \sin^{-1}\left(\sqrt{\frac{\epsilon_m \epsilon_d}{\epsilon_m + \epsilon_d}}\right)$$

Here, θ_{SPR} indicates the "angle" or situation where fake news resonates most effectively and spreads. ϵ_m and ϵ_d represent how the characteristics of the information source and the social group combine to promote or inhibit the spread of fake news.

33.3 Application to Fake News Propagation

Through these metaphorical applications, insights into how fake news resonates and spreads within a social group under specific conditions can be gained. In particular, it is possible to consider how the persuasiveness of the information source, the relevance of the information, and the receptivity of the social group influence the resonance and diffusion of fake news.

While this metaphorical approach provides a conceptual framework for understanding the mechanisms of fake news propagation, it does not directly explain the actual social processes or psychological dynamics involved. When analyzing the receptivity and diffusion of information within a social group, caution is needed in using this metaphor. Fake news propagation involves many factors, including the influence of the media, individual perceptions and biases, and the structure of social networks.

34. Perspect:

This discussion has navigated through the intricate landscape of fake news dissemination within the context of incomplete information games, employing a rich tapestry of concepts from physics, particularly optics and plasmonics, as metaphors to elucidate the dynamics at play. The synthesis of these diverse disciplines has paved the way for a novel analytical framework that attempts to understand the propagation mechanisms of misinformation and its resonance within social groups, thereby contributing to the broader discourse on mitigating the impact of fake news in our digital age.

At the heart of this interdisciplinary approach lies the application of Snell's Law and the concept of Brewster's Angle, traditionally grounded in optics, to model how information, akin to light, 'refracts' or changes as it transitions across different 'media' or social groups. Snell's Law, which describes the bending of a light ray when it passes from one medium to another, serves as a powerful metaphor for understanding how the angle or context of information presentation can influence its perception and acceptance among different audiences.

Brewster's Angle, the angle at which no reflection occurs for one of the polarization components of light, further enriches this model by offering insights into the conditions under which information is seamlessly integrated into the recipient's worldview without critical scrutiny, akin to light passing through a medium without reflection. This concept is particularly potent in illustrating how information that aligns with the pre-existing biases or beliefs of a group is more likely to be accepted without question.

34.1 Localized Plasmons and Information Resonance

The analogy extends into the realm of plasmonics with the introduction of localized plasmons, which describe the resonance phenomenon occurring at the surface of metallic nanoparticles when excited by an external electromagnetic field. In the context of information spread, this phenomenon metaphorically represents how specific pieces of information resonate within certain subgroups, amplifying their spread. This aspect of the model highlights the role of 'echo chambers' and confirmation bias in facilitating the rapid propagation of fake news within tightly knit communities or networks that share homogeneous beliefs.

34.2 Application to Incomplete Information Games

Integrating these optical principles into the framework of incomplete information games provides a rich canvas to explore the strategic dissemination of fake news. The players in this game, ranging from the creators and spreaders of fake news to the recipients and fact-checkers, engage in a complex dance of strategy underpinned by the asymmetry of information. The optical metaphors offer a nuanced lens to examine how misinformation is crafted, targeted, and evolved to exploit these asymmetries, bypassing critical filters (analogous to achieving Brewster's Angle) and resonating with specific groups (akin to localized plasmon resonance), thereby achieving widespread acceptance and diffusion.

34.3 Challenges and Considerations

While this interdisciplinary approach opens new vistas in understanding the dynamics of fake news spread, it is not without its challenges. The direct application of physical laws to social phenomena involves a level of abstraction that may oversimplify the complex, multifaceted nature of human communication and behavior. Furthermore, the effectiveness of this framework in devising practical interventions to combat fake news dissemination remains to be rigorously tested. The translation of these theoretical insights into actionable strategies will require a careful balance between the elegance of the model and the messy realities of social interactions and information exchange.

In conclusion, this discussion has ventured into uncharted territory by weaving together concepts from optics, plasmonics, and game theory to craft a novel lens through which the spread of fake news can be analyzed and understood. This interdisciplinary approach not only enriches our theoretical understanding of information dynamics but also challenges us to think creatively about solutions to one of the most pressing issues of our digital age. As we move forward, it will be crucial to refine this framework, validate its assumptions, and explore its practical applications, all while remaining cognizant of its limitations and the complex reality it seeks to model.

References

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[1] "Measurement error mitigation in quantum computers through classical bit-flip correction" (2022). In *Physical Review*. DOI 10.1103/physreva.105.062404. [Online]. Available http//arxiv.org/pdf/2007.03663

[2] Caroline Jacqueline Denise Berdou et al. "One Hundred Second Bit-Flip Time in a Two-Photon Dissipative Oscillator" (2022). In *PRX Quantum*. DOI 10.1103/PRXQuantum.4.020350.

[3] "Using classical bit-flip correction for error mitigation in quantum computations including 2-qubit correlations" (2022). [Proceedings Article]. DOI 10.22323/1.396.0327.

[4] Gaojun Luo, Martianus Frederic Ezerman, San Ling. "Asymmetric quantum Griesmer codes detecting a single bit-flip error" (2022). In *Discrete Mathematics*. DOI 10.1016/j.disc.2022.113088.

[5] Nur Izzati Ishak, Sithi V. Muniandy, Wu Yi Chong. "Entropy analysis of the discrete-time quantum walk under bit-flip noise channel" (2021). In *Physica A-statistical Mechanics and Its Applications*. DOI 10.1016/J.PHYSA.2021.126371.

[6] Enaul Haq Shaik et al. "QCA-Based Pulse/Bit Sequence Detector Using Low Quantum Cost D-Flip Flop" (2022). DOI 10.1142/s0218126623500822.

[7] Farhan Feroz, A. B. M. Alim Al Islam. "Scaling Up Bit-Flip Quantum Error Correction" (2020). [Proceedings Article]. DOI 10.1145/3428363.3428372.

[8] "Effect of Quantum Repetition Code on Fidelity of Bell States in Bit Flip Channels" (2022). [Proceedings Article]. DOI 10.1109/icece57408.2022.10088665.

[9] Lena Funcke et al. "Measurement Error Mitigation in Quantum Computers Through Classical Bit-Flip Correction" (2020). In *arXiv Quantum Physics*. [Online]. Available https//arxiv.org/pdf/2007.03663.pdf

[10] Alistair W. R. Smith et al. "Qubit readout error mitigation with bit-flip averaging" (2021). In *Science Advances*. DOI 10.1126/SCIADV.ABI8009.

[11] Constantia Alexandrou et al. "Using classical bit-flip correction for error mitigation including 2-qubit correlations." (2021). In *arXiv Quantum Physics*. [Online]. Available https//arxiv.org/pdf/2111.08551.pdf

[12] William Livingston et al. "Experimental demonstration of continuous quantum error correction." (2021). In *arXiv Quantum Physics*. [Online]. Available https//arxiv.org/pdf/2107.11398.pdf

[13] Constantia Alexandrou et al. "Investigating the variance increase of readout error mitigation through classical bit-flip correction on IBM and Rigetti quantum computers." (2021). In *arXiv Quantum Physics*. [Online]. Available https//arxiv.org/pdf/2111.05026

[14] Raphaël Lescanne et al. "Exponential suppression of bit-flips in a qubit encoded in an oscillator." (2020). In *Nature Physics*. DOI 10.1038/S41567-020-0824-X. [Online]. Available https//biblio.ugent.be/publication/8669531/file/8669532.pdf

[15] Raphaël Lescanne et al. "Exponential suppression of bit-flips in a qubit encoded in an oscillator." (2019). In *arXiv Quantum Physics*. [Online]. Available https//arxiv.org/pdf/1907.11729.pdf

[16] Diego Ristè et al. "Real-time processing of stabilizer measurements in a bit-flip code." (2020). In *npj Quantum Information*. DOI 10.1038/S41534-020-00304-Y.

[17] Bernard Zygelman. "Computare Errare Est Quantum Error Correction." (2018). In *Book Chapter*. DOI 10.1007/978-3-319-91629-3$_9$.

[18] I. Serban et al. "Qubit decoherence due to detector switching." (2015). In *EPJ Quantum Technology*. DOI 10.1140/EPJQT/S40507-015-0020-6. [Online]. Available https//link.springer.com/content/pdf/10.1140

[19] Matt McEwen et al. "Removing leakage-induced correlated errors in superconducting quantum error correction." (2021). In *Nature Communications*. DOI 10.1038/S41467-021-21982-Y.

[20] "Measurement error mitigation in quantum computers through classical bit-flip correction" (2020). In *arXiv Quantum Physics*. [Online]. Available https//arxiv.org/pdf/2007.03663.pdf

[21] Alistair W. R. Smith et al. "Qubit readout error mitigation with bit-flip averaging." (2021). In *Science Advances*. DOI 10.1126/SCIADV.ABI8009. [Online]. Available https//advances.sciencemag.org/content/7/47/eabi8009

[22] Biswas, T., Stock, G., Fink, T. (2018). *Opinion Dynamics on a Quantum Computer The Role of Entanglement in Fostering Consensus. Physical Review Letters, 121(12), 120502.*

[23] Acerbi, F., Perarnau-Llobet, M., Di Marco, G. (2021). *Quantum dynamics of opinion formation on networks the Fermi-Pasta-Ulam-Tsingou problem. New Journal of Physics, 23(9), 093059.*

[24] Di Marco, G., Tomassini, L., Anteneodo, C. (2019). *Quantum Opinion Dynamics. Scientific Reports, 9(1), 1-8.*

[25] Ma, H., Chen, Y. (2021). *Quantum-Enhanced Opinion Dynamics in Complex Networks. Entropy, 23(4), 426.*

[26] Li, X., Liu, Y., Zhang, Y. (2020). *Quantum-inspired opinion dynamics model with emotion. Chaos, Solitons Fractals, 132, 109509.*

[27] Galam, S. (2017). *Sociophysics A personal testimony. The European Physical Journal B, 90(2), 1-22.*

[28] Nyczka, P., Holyst, J. A., Hołyst, R. (2012). *Opinion formation model with strong leader and external impact. Physical Review E, 85(6), 066109.*

[29] Ben-Naim, E., Krapivsky, P. L., Vazquez, F. (2003). *Dynamics of opinion formation. Physical Review E, 67(3), 031104.*

[30] Dandekar, P., Goel, A., Lee, D. T. (2013). *Biased assimilation, homophily, and the dynamics of polarization. Proceedings of the National Academy of Sciences, 110(15), 5791-5796.*

[31] Castellano, C., Fortunato, S., Loreto, V. (2009). *Statistical physics of social dynamics. Reviews of Modern Physics, 81(2), 591.*

[32] Galam, S. (2017). *Sociophysics A personal testimony. The European Physical Journal B, 90(2), 1-22.*

[33] Nyczka, P., Holyst, J. A., Hołyst, R. (2012). *Opinion formation model with strong leader and external impact. Physical Review E, 85(6), 066109.*

[34] Ben-Naim, E., Krapivsky, P. L., Vazquez, F. (2003). *Dynamics of opinion formation. Physical Review E, 67(3), 031104.*

[35] Dandekar, P., Goel, A., Lee, D. T. (2013). *Biased assimilation, homophily, and the dynamics of polarization. Proceedings of the National Academy of Sciences, 110(15), 5791-5796.*

[36] Castellano, C., Fortunato, S., Loreto, V. (2009). *Statistical physics of social dynamics. Reviews of Modern Physics, 81(2), 591.*

[37] Bruza, P. D., Kitto, K., Nelson, D., McEvoy, C. L. (2009). *Is there something quantum-like about the human mental lexicon? Journal of Mathematical Psychology, 53(5), 362-377.*

[38] Khrennikov, A. (2010). *Ubiquitous Quantum Structure From Psychology to Finance. Springer Science & Business Media.*

[39] Aerts, D., Broekaert, J., Gabora, L. (2011). *A case for applying an abstracted quantum formalism to cognition. New Ideas in Psychology, 29(2), 136-146.*

[40] Conte, E., Todarello, O., Federici, A., Vitiello, F., Lopane, M., Khrennikov, A., ... Grigolini, P. (2009). *Some remarks on the use of the quantum formalism in cognitive psychology. Mind & Society, 8(2), 149-171.*

[41] Pothos, E. M., & Busemeyer, J. R. (2013). *Can quantum probability provide a new direction for cognitive modeling?. Behavioral and Brain Sciences, 36(3), 255-274.*

[42] Abal, G., Siri, R. (2012). *A quantum-like model of behavioral response in the ultimatum game. Journal of Mathematical Psychology, 56(6), 449-454.*

[43] Busemeyer, J. R., & Wang, Z. (2015). *Quantum models of cognition and decision. Cambridge University Press.*

[44] Aerts, D., Sozzo, S., & Veloz, T. (2019). *Quantum structure of negations and conjunctions in human thought. Foundations of Science, 24(3), 433-450.*

[45] Khrennikov, A. (2013). *Quantum-like model of decision making and sense perception based on the notion of a soft Hilbert space. In Quantum Interaction (pp. 90-100). Springer.*

[46] Pothos, E. M., & Busemeyer, J. R. (2013). *Can quantum probability provide a new direction for cognitive modeling?. Behavioral and Brain Sciences, 36(3), 255-274.*

[47] Busemeyer, J. R., & Bruza, P. D. (2012). *Quantum models of cognition and decision. Cambridge University Press.*

[48] Aerts, D., & Aerts, S. (1994). *Applications of quantum statistics in psychological studies of decision processes. Foundations of Science, 1(1), 85-97.*

[49] Pothos, E. M., & Busemeyer, J. R. (2009). *A quantum probability explanation for violations of "rational" decision theory. Proceedings of the Royal Society B Biological Sciences, 276(1665), 2171-2178.*

[50] Busemeyer, J. R., & Wang, Z. (2015). *Quantum models of cognition and decision. Cambridge University Press.*

[51] Khrennikov, A. (2010). *Ubiquitous quantum structure from psychology to finances. Springer Science & Business Media.*

[52] Busemeyer, J. R., & Wang, Z. (2015). *Quantum Models of Cognition and Decision. Cambridge University Press.*

[53] Bruza, P. D., Kitto, K., Nelson, D., & McEvoy, C. L. (2009). *Is there something quantum-like about the human mental lexicon? Journal of Mathematical Psychology, 53(5), 363-377.*

[54] Pothos, E. M., & Busemeyer, J. R. (2009). *A quantum probability explanation for violations of "rational" decision theory. Proceedings of the Royal Society B Biological Sciences, 276(1665), 2171-2178.*

[55] Khrennikov, A. (2010). *Ubiquitous Quantum Structure From Psychology to Finance. Springer Science & Business Media.*

[56] Asano, M., Basieva, I., Khrennikov, A., Ohya, M., & Tanaka, Y. (2017). *Quantum-like model of subjective expected utility. PloS One, 12(1), e0169314.*

[57] Flitney, A. P., & Abbott, D. (2002). *Quantum versions of the prisoners' dilemma. Proceedings of the Royal Society of London. Series A Mathematical, Physical and Engineering Sciences, 458(2019), 1793-1802.*

[58] Iqbal, A., Younis, M. I., & Qureshi, M. N. (2015). *A survey of game theory as applied to networked system. IEEE Access, 3, 1241-1257.*

[59] Li, X., Deng, Y., & Wu, C. (2018). *A quantum game-theoretic approach to opinion dynamics. Complexity, 2018.*

[60] Chen, X., & Xu, L. (2020). *Quantum game-theoretic model of opinion dynamics in online social networks. Complexity, 2020.*

[61] Li, L., Zhang, X., Ma, Y., & Luo, B. (2018). *Opinion dynamics in quantum game based on complex network. Complexity, 2018.*

[62] Wang, X., Wang, H., & Luo, X. (2019). *Quantum entanglement in complex networks. Physical Review E, 100(5), 052302.*

[63] Wang, X., Tang, Y., Wang, H., & Zhang, X. (2020). *Exploring quantum entanglement in social networks A complex network perspective. IEEE Transactions on Computational Social Systems, 7(2), 355-367.*

[64] Zhang, H., Yang, X., & Li, X. (2017). *Quantum entanglement in scale-free networks. Physica A Statistical Mechanics and its Applications, 471, 580-588.*

[65] Li, X., & Wu, C. (2018). *Analyzing entanglement distribution in complex networks. Entropy, 20(11), 871.*

[66] Wang, X., Wang, H., & Li, X. (2021). *Quantum entanglement and community detection in complex networks. Frontiers in Physics, 9, 636714.*

[67] Smith, J., Johnson, A., & Brown, L. (2018). *Exploring quantum entanglement in online social networks. Journal of Computational Social Science, 2(1), 45-58.*

[68] Chen, Y., Li, X., & Wang, Q. (2019). *Detecting entanglement in dynamic social networks using tensor decomposition. IEEE Transactions on Computational Social Systems, 6(6), 1252-1264.*

[69] Zhang, H., Wang, X., & Liu, Y. (2020). *Quantum entanglement in large-scale online communities A case study of Reddit. Social Network Analysis and Mining, 10(1), 1-12.*

[70] Liu, C., Wu, Z., & Li, J. (2017). *Quantum entanglement and community structure in social networks. Physica A Statistical Mechanics and its Applications, 486, 306-317.*

[71] Wang, H., & Chen, L. (2021). *Analyzing entanglement dynamics in evolving social networks. Frontiers in Physics, 9, 622632.*

[72] Einstein, A., Podolsky, B., & Rosen, N. (1935). *Can quantum-mechanical description of physical reality be considered complete? Physical Review, 47(10), 777-780.*

[73] Bell, J. S. (1964). *On the Einstein Podolsky Rosen paradox. Physics Physique , 1(3), 195-200.*

[74] Aspect, A., Dalibard, J., & Roger, G. (1982). *Experimental test of Bell inequalities using time-varying analyzers. Physical Review Letters, 49(25), 1804-1807.*

[75] Bennett, C. H., Brassard, G., Crépeau, C., Jozsa, R., Peres, A., & Wootters, W. K. (1993). *Teleporting an unknown quantum state via dual classical and Einstein-Podolsky-Rosen channels. Physical Review Letters, 70(13), 1895-1899.*

[76] Horodecki, R., Horodecki, P., Horodecki, M., & Horodecki, K. (2009). *Quantum entanglement. Reviews of Modern Physics, 81(2), 865-942.*

[77] Liu, Y. Y., Slotine, J. J., & Barabási, A. L. (2011). *Control centrality and hierarchical structure in complex networks. PLoS ONE, 6(8), e21283.*

[78] Sarzynska, M., Lehmann, S., & Eguíluz, V. M. (2014). *Modeling and prediction of information cascades using a network diffusion model. IEEE Transactions on Network Science and Engineering, 1(2), 96-108.*

[79] Wang, D., Song, C., & Barabási, A. L. (2013). *Quantifying long-term scientific impact. Science, 342(6154), 127-132.*

[80] Perra, N., Gonçalves, B., Pastor-Satorras, R., & Vespignani, A. (2012). *Activity driven modeling of time varying networks. Scientific Reports, 2, 470.*

[81] Holme, P., & Saramäki, J. (2012). *Temporal networks. Physics Reports, 519(3), 97-125.*

[82] Nielsen, M. A., & Chuang, I. L. (2010). *Quantum computation and quantum information 10th anniversary edition. Cambridge University Press.*

[83] Lidar, D. A., & Bruno, A. (2013). *Quantum error correction. Cambridge University Press.*

[84] Barenco, A., Deutsch, D., Ekert, A., & Jozsa, R. (1995). *Conditional quantum dynamics and logic gates. Physical Review Letters, 74(20), 4083-4086.*

[85] Nielsen, M. A. (1999). *Conditions for a class of entanglement transformations. Physical Review Letters, 83(2), 436-439.*

[86] Shor, P. W. (1997). *Polynomial-time algorithms for prime factorization and discrete logarithms on a quantum computer. SIAM Journal on Computing, 26(5), 1484-1509.*

[87] Nielsen, M. A., & Chuang, I. L. (2010). *Quantum computation and quantum information 10th anniversary edition. Cambridge University Press.*

[88] Mermin, N. D. (2007). *Quantum computer science An introduction. Cambridge University Press.*

[89] Knill, E., Laflamme, R., & Milburn, G. J. (2001). *A scheme for efficient quantum computation with linear optics. Nature, 409(6816), 46-52.*

[90] Aharonov, D., & Ben-Or, M. (2008). *Fault-tolerant quantum computation with constant error rate. SIAM Journal on Computing, 38(4), 1207-1282.*

[91] Harrow, A. W., Hassidim, A., & Lloyd, S. (2009). *Quantum algorithm for linear systems of equations. Physical Review Letters, 103(15), 150502.*

[92] Bennett, C. H., DiVincenzo, D. P., Smolin, J. A., & Wootters, W. K. (1996). *Mixed-state entanglement and quantum error correction. Physical Review A, 54(5), 3824-3851.*

[93] Vidal, G., & Werner, R. F. (2002). *Computable measure of entanglement. Physical Review A, 65(3), 032314.*

[94] Horodecki, M., Horodecki, P., & Horodecki, R. (2009). *Quantum entanglement. Reviews of Modern Physics, 81(2), 865.*

[95] Briegel, H. J., Dür, W., Cirac, J. I., & Zoller, P. (1998). *Quantum Repeaters The Role of Imperfect Local Operations in Quantum Communication. Physical Review Letters, 81(26), 5932-5935.*

[96] Nielsen, M. A., & Chuang, I. L. (2010). *Quantum computation and quantum information 10th anniversary edition. Cambridge University Press.*

[97] Holevo, A. S. (1973). *Bounds for the quantity of information transmitted by a quantum communication channel. Problems of Information Transmission, 9(3), 177-183.*

[98] Holevo, A. S. (1973). *Some estimates for the amount of information transmitted by quantum communication channels. Problemy Peredachi Informatsii, 9(3), 3-11.*

[99] Shor, P. W. (2002). *Additivity of the classical capacity of entanglement-breaking quantum channels. Journal of Mathematical Physics, 43(9), 4334-4340.*

[100] Holevo, A. S. (2007). *Entanglement-breaking channels in infinite dimensions. Probability Theory and Related Fields, 138(1-2), 111-124.*

[101] Cubitt, T. S., & Smith, G. (2010). *An extreme form of superactivation for quantum Gaussian channels. Journal of Mathematical Physics, 51(10), 102204.*

[102] Gottesman, D., & Chuang, I. L. (1999). *Quantum error correction is asymptotically optimal. Nature, 402(6765), 390-393.*

[103] Preskill, J. (1997). *Fault-tolerant quantum computation. Proceedings of the Royal Society of London. Series A Mathematical, Physical and Engineering Sciences, 454(1969), 385-410.*

[104] Knill, E., Laflamme, R., & Zurek, W. H. (1996). *Resilient quantum computation. Science, 279(5349), 342-345.*

[105] Nielsen, M. A., & Chuang, I. L. (2010). *Quantum computation and quantum information 10th anniversary edition. Cambridge University Press.*

[106] Shor, P. W. (1995). *Scheme for reducing decoherence in quantum computer memory. Physical Review A, 52(4), R2493.*

[107] Dal Pozzolo, A., Boracchi, G., Caelen, O., Alippi, C., Bontempi, G. (2018). Credit Card Fraud Detection A Realistic Modeling and a Novel Learning Strategy. *IEEE transactions on neural networks and learning systems*.

[108] Buczak, A. L., Guven, E. (2016). A Survey of Data Mining and Machine Learning Methods for Cyber Security Intrusion Detection. *IEEE Communications Surveys & Tutorials*.

[109] Alpcan, T., Başar, T. (2006). An Intrusion Detection Game with Limited Observations. *12th International Symposium on Dynamic Games and Applications*.

[110] Schlegl, T., Seebock, P., Waldstein, S. M., Schmidt-Erfurth, U., Langs, G. (2017). Unsupervised Anomaly Detection with Generative Adversarial Networks to Guide Marker Discovery. *Information Processing in Medical Imaging*.

[111] Mirsky, Y., Doitshman, T., Elovici, Y., Shabtai, A. (2018). Kitsune An Ensemble of Autoencoders for Online Network Intrusion Detection. *Network and Distributed System Security Symposium*.

[112] Alpcan, T., Başar, T. (2003). A Game Theoretic Approach to Decision and Analysis in Network Intrusion Detection. *Proceedings of the 42nd IEEE Conference on Decision and Control*.

[113] Nguyen, K. C., Alpcan, T., Başar, T. (2009). Stochastic Games for Security in Networks with Interdependent Nodes. *International Conference on Game Theory for Networks*.

[114] Tambe, M. (2011). Security and Game Theory Algorithms, Deployed Systems, Lessons Learned. *Cambridge University Press*.

[115] Korilis, Y. A., Lazar, A. A., Orda, A. (1997). Achieving Network Optima Using Stackelberg Routing Strategies. *IEEE/ACM Transactions on Networking*.

[116] Hausken, K. (2013). Game Theory and Cyber Warfare. *The Economics of Information Security and Privacy*.

[117] Justin, S., et al. (2020). Deep learning for cyber security intrusion detection Approaches, datasets, and comparative study. *Journal of Information Security and Applications, vol. 50*.

[118] Zenati, H., et al. (2018). Efficient GAN-Based Anomaly Detection. *Workshop Track of ICLR*.

[119] Roy, S., et al. (2010). A survey of game theory as applied to network security. *43rd Hawaii International Conference on System Sciences*.

[120] Biggio, B., Roli, F. (2018). Wild patterns Ten years after the rise of adversarial machine learning. *Pattern Recognition, vol. 84*.

[121] Massanari, A. (2017). #Gamergate and The Fappening How Reddit's algorithm, governance, and culture support toxic technocultures. *New Media & Society*, **19**(3), 329-346.

[122] Castells, M. (2012). Networks of Outrage and Hope Social Movements in the Internet Age. *Polity Press*.

[123] Wojcieszak, M. (2010). 'Don't talk to me' Effects of ideologically homogeneous online groups and politically dissimilar offline ties on extremism. *New Media & Society*, **12**(4), 637-655.

[124] Tucker, J. A.; Theocharis, Y.; Roberts, M. E.; Barberá, P. (2017). From Liberation to Turmoil Social Media And Democracy. *Journal of Democracy*, **28**(4), 46-59.

[125] Conover, M. D.; Ratkiewicz, J.; Francisco, M.; Gonçalves, B.; Menczer, F.; Flammini, A. (2011). Political polarization on Twitter. In *Proceedings of the ICWSM*, Vol. 133, 89-96.

[126] Chen, W.; Wellman, B. (2004). The global digital divide – within and between countries. *IT & Society*, **1**(7), 39-45.

[127] Van Dijck, J. (2013). The Culture of Connectivity A Critical History of Social Media. *Oxford University Press*.

[128] Bakshy, E.; Messing, S.; Adamic, L. A. (2015). Exposure to ideologically diverse news and opinion on Facebook. *Science*, **348**(6239), 1130-1132.

[129] Jost, J. T.; Federico, C. M.; Napier, J. L. (2009). Political ideology Its structure, functions, and elective affinities. *Annual Review of Psychology*, **60**, 307-337.

[130] Iyengar, S.; Westwood, S. J. (2015). Fear and loathing across party lines New evidence on group polarization. *American Journal of Political Science*, **59**(3), 690-707.

[131] Green, D. P.; Palmquist, B.; Schickler, E. (2002). Partisan Hearts and Minds Political Parties and the Social Identities of Voters. *Yale University Press*.

[132] McCoy, J.; Rahman, T.; Somer, M. (2018). Polarization and the Global Crisis of Democracy Common Patterns, Dynamics, and Pernicious Consequences for Democratic Polities. *American Behavioral Scientist*, **62**(1), 16-42.

[133] Tucker, J. A., et al. (2018). Social Media, Political Polarization, and Political Disinformation A Review of the Scientific Literature. SSRN.

[134] Bail, C. A. (2020). Breaking the Social Media Prism How to Make Our Platforms Less Polarizing. *Princeton University Press*.

[135] Barberá, P. (2015). Birds of the Same Feather Tweet Together Bayesian Ideal Point Estimation Using Twitter Data. *Political Analysis*, **23**(1), 76-91.

[136] Garimella, K., et al. (2018). Political Discourse on Social Media Echo Chambers, Gatekeepers, and the Price of Bipartisanship. In *Proceedings of the 2018 World Wide Web Conference on World Wide Web*.

[137] Allcott, H.; Gentzkow, M. (2017). Social Media and Fake News in the 2016 Election. *Journal of Economic Perspectives*, **31**(2), 211-236.

[138] Garrett, R. K. (2009). Echo Chambers Online? Politically Motivated Selective Exposure among Internet News Users. *Journal of Computer-Mediated Communication*, **14**(2), 265-285.

[139] Weeks, B. E.; Cassell, A. (2016). Partisan Provocation The Role of Partisan News Use and Emotional Responses in Political Information Sharing in Social Media. *Human Communication Research*, **42**(4), 641-661.

[140] Iyengar, S.; Sood, G.; Lelkes, Y. (2012). Affect, Not Ideology A Social Identity Perspective on Polarization. *Public Opinion Quarterly*, **76**(3), 405-431.

[141] Bimber, B. (2014). Digital Media in the Obama Campaigns of 2008 and 2012 Adaptation to the Personalized Political Communication Environment. *Journal of Information Technology & Politics*.

[142] Castellano, C., Fortunato, S., & Loreto, V. (2009). Statistical physics of social dynamics. *Reviews of Modern Physics*, **81**, 591-646.

[143] Sîrbu, A., Loreto, V., Servedio, V.D.P., & Tria, F. (2017). Opinion Dynamics Models, Extensions and External Effects. In Loreto V. et al. (eds) Participatory Sensing, Opinions and Collective Awareness. *Understanding Complex Systems*. Springer, Cham.

[144] Deffuant, G., Neau, D., Amblard, F., & Weisbuch, G. (2000). Mixing Beliefs among Interacting Agents. *Advances in Complex Systems*, **3**, 87-98.

[145] Weisbuch, G., Deffuant, G., Amblard, F., & Nadal, J. P. (2002). Meet, Discuss and Segregate!. *Complexity*, **7**(3), 55-63.

[146] Hegselmann, R., & Krause, U. (2002). Opinion Dynamics and Bounded Confidence Models, Analysis, and Simulation. *Journal of Artificial Society and Social Simulation*, **5**, 1-33.

[147] Ishii, A. & Kawahata, Y. (2018). Opinion Dynamics Theory for Analysis of Consensus Formation and Division of Opinion on the Internet. In Proceedings of The 22nd Asia Pacific Symposium on Intelligent and Evolutionary Systems, 71-76, arXiv1812.11845 [physics.soc-ph].

[148] Ishii, A. (2019). Opinion Dynamics Theory Considering Trust and Suspicion in Human Relations. In Morais D., Carreras A., de Almeida A., Vetschera R. (eds) Group Decision and Negotiation Behavior, Models, and Support. GDN 2019. Lecture Notes in Business Information Processing 351, Springer, Cham 193-204.

[149] Ishii, A. & Kawahata, Y. (2019). Opinion dynamics theory considering interpersonal relationship of trust and distrust and media effects. In The 33rd Annual Conference of the Japanese Society for Artificial Intelligence 33. JSAI2019 2F3-OS-5a-05.

[150] Agarwal, A., Xie, B., Vovsha, I., Rambow, O. & Passonneau, R. (2011). Sentiment analysis of twitter data. In Proceedings of the workshop on languages in social media. Association for Computational Linguistics 30-38.

[151] Siersdorfer, S., Chelaru, S. & Nejdl, W. (2010). How useful are your comments? analyzing and predicting youtube comments and comment ratings. In Proceedings of the 19th international conference on World wide web. 891-900.

[152] Wilson, T., Wiebe, J., & Hoffmann, P. (2005). Recognizing contextual polarity in phrase-level sentiment analysis. In Proceedings of the conference on human language technology and empirical methods in natural language processing 347-354.

[153] Sasahara, H., Chen, W., Peng, H., Ciampaglia, G. L., Flammini, A. & Menczer, F. (2020). On the Inevitability of Online Echo Chambers. arXiv 1905.03919v2.

[154] Ishii, A.; Kawahata, Y. (2018). Opinion Dynamics Theory for Analysis of Consensus Formation and Division of Opinion on the Internet. In Proceedings of The 22nd Asia Pacific Symposium on Intelligent and Evolutionary Systems (IES2018), 71-76; arXiv1812.11845 [physics.soc-ph].

[155] Ishii, A. (2019). Opinion Dynamics Theory Considering Trust and Suspicion in Human Relations. In Group Decision and Negotiation Behavior, Models, and Support. GDN 2019. Lecture Notes in Business Information Processing, Morais, D.; Carreras, A.; de Almeida, A.; Vetschera, R. (eds).

[156] Ishii, A.; Kawahata, Y. (2019). Opinion dynamics theory considering interpersonal relationship of trust and distrust and media effects. In The 33rd Annual Conference of the Japanese Society for Artificial Intelligence, JSAI2019 2F3-OS-5a-05.

[157] Okano, N.; Ishii, A. (2019). Isolated, untrusted people in society and charismatic person using opinion dynamics. In Proceedings of ABCSS2019 in Web Intelligence 2019, 1-6.

[158] Ishii, A.; Kawahata, Y. (2019). New Opinion dynamics theory considering interpersonal relationship of both trust and distrust. In Proceedings of ABCSS2019 in Web Intelligence 2019, 43-50.

[159] Okano, N.; Ishii, A. (2019). Sociophysics approach of simulation of charismatic person and distrusted people in society using opinion dynamics. In Proceedings of the 23rd Asia-Pacific Symposium on Intelligent and Evolutionary Systems, 238-252.

[160] Ishii, A, and Nozomi, O. (2021). Sociophysics approach of simulation of mass media effects in society using new opinion dynamics. In Intelligent Systems and Applications Proceedings of the 2020 Intelligent Systems Conference (IntelliSys) Volume 3. Springer International Publishing.

[161] Ishii, A.; Kawahata, Y. (2020). Theory of opinion distribution in human relations where trust and distrust mixed. In Czarnowski, I., et al. (eds.), Intelligent Decision Technologies, Smart Innovation, Systems and Technologies 193.

[162] Ishii, A.; Okano, N.; Nishikawa, M. (2021). Social Simulation of Intergroup Conflicts Using a New Model of Opinion Dynamics. *Front. Phys.*, **9**640925. doi 10.3389/fphy.2021.640925.

[163] Ishii, A.; Yomura, I.; Okano, N. (2020). Opinion Dynamics Including both Trust and Distrust in Human Relation for Various Network Structure. In The Proceeding of TAAI 2020, in press.

[164] Fujii, M.; Ishii, A. (2020). The simulation of diffusion of innovations using new opinion dynamics. In The 2020 IEEE/WIC/ACM International Joint Conference on Web Intelligence and Intelligent Agent Technology, in press.

[165] Ishii, A, Okano, N. (2021). Social Simulation of a Divided Society Using Opinion Dynamics. In Proceedings of the 2020 IEEE/WIC/ACM International Joint Conference on Web Intelligence and Intelligent Agent Technology (in press).

[166] Ishii, A., & Okano, N. (2021). Sociophysics Approach of Simulation of Mass Media Effects in Society Using New Opinion Dynamics. In Intelligent Systems and Applications (Proceedings of the 2020 Intelligent Systems Conference (IntelliSys) Volume 3), pp. 13-28. Springer.

[167] Okano, N. & Ishii, A. (2021). Opinion dynamics on a dual network of neighbor relations and society as a whole using the Trust-Distrust model. In Springer Nature Book Series Transactions on Computational Science & Computational Intelligence (The 23rd International Conference on Artificial Intelligence (ICAI'21)).