



Behavior Percolation in Closed and Open Social Spaces

**Prof. Dr. Petre Dini, ex-AT&T/Cisco Systems, Inc., USA
(retired)**

**Prof. Dr. Nitin Agarwal, COSMOS Research Center, University
of Arkansas at Little Rock; ICSI, University of California,
Berkeley, USA**



- **Social Network behavior**
- **Coalitions (Prevent, Detect, Break)**
- **Presence and Participation (Open & Closed Space)**
- **Mediated Communications**
- **Private and Public Percolation Thresholds**
- **Time and Attention**
- **Adaptation and Social Learning**
- **Natural and Induced Percolation**

■ Fight and annihilate malicious coalitions

- Social media users (innocent followers)
- Agents in an agentic (autonomous (?) behavior & hallucinations)
- Hackers (on purpose, bad players)
- Well-known example: DDoS

■ Monitor and delay (prevent) percolation points

- Anticipatory percolation points
- Prevention of percolation points
- Detect early igniters of to-be percolation points
- Detect last actors before percolation points

■ Improving

Resiliency
Robustness
Predictability
Survivability

■ Mechanisms

Detection
Prevention & mitigation
Escalation control & containment
Social/physical networks analogy

Detection Mechanisms

These aim to **identify critical nodes/edges** before percolation cascades into escalation.

- **Percolation Centrality:** Extends betweenness centrality by measuring how often a node lies on the percolation paths; highlights escalation “hubs.”
- **K-core / K-shell Decomposition:** Identifies tightly connected subgroups that can ignite coalition percolation.
- **Spectral Methods:** Use eigenvalue gaps of adjacency or Laplacian matrices to detect vulnerable clusters.
- **Dynamic Early-Warning Indicators:** Monitor for rising variance, correlation, or lag in activity (critical slowing down); signals that escalation thresholds are near.
- **Community Evolution Tracking:** Detects when benign communities merge into larger, potentially destabilizing coalitions.
- **Multilayer Cross-Monitoring:** Correlates physical (infrastructure load) and social (information diffusion) layers to identify compound percolation risks.

Prevention & Mitigation Mechanisms

These mechanisms are aimed at **breaking or slowing percolation cascades** once hotspots are identified.

- **Edge Rewiring or Weakening:** In social networks, introducing “noise” edges or weakening strong ties to disrupt coalition reinforcement.
- **Immunization Strategies:** Selectively “inoculate” nodes (informationally or with safeguards) based on high percolation centrality.
- **Decoy Communities:** Create attractive but controlled coalitions to absorb and dilute escalation energy.
- **Load Balancing in Physical Networks:** Redistribute flows to prevent cascading overload (analogous to slowing rumor/attack spread in social systems).
- **Temporal Firebreaks:** Slow information propagation using throttling, rate-limits, or moderation to prevent synchronous coalition formation.
- **Adaptive Governance Agents:** Deploy monitoring AI agents that intervene with fact-checking, counter-narratives, or rerouting at early escalation points.

Escalation Control & Containment

If percolation starts, focus shifts to limiting systemic damage.

- **Cascading Failure Dampers:** In physical networks (e.g., power grids), trip-switches or circuit breakers limit the escalation chain.
- **Influence Containment Policies:** Temporarily isolate or de-amplify influential coalition leaders in digital platforms.
- **Layered Defense-in-Depth:** Combine physical resilience (redundancy, segmentation) with social countermeasures (alternative narratives, community support).
- **Feedback Suppression:** Break reinforcing loops in escalation (e.g., social recommendation systems amplifying bad coalitions).

Analogy Across Domains

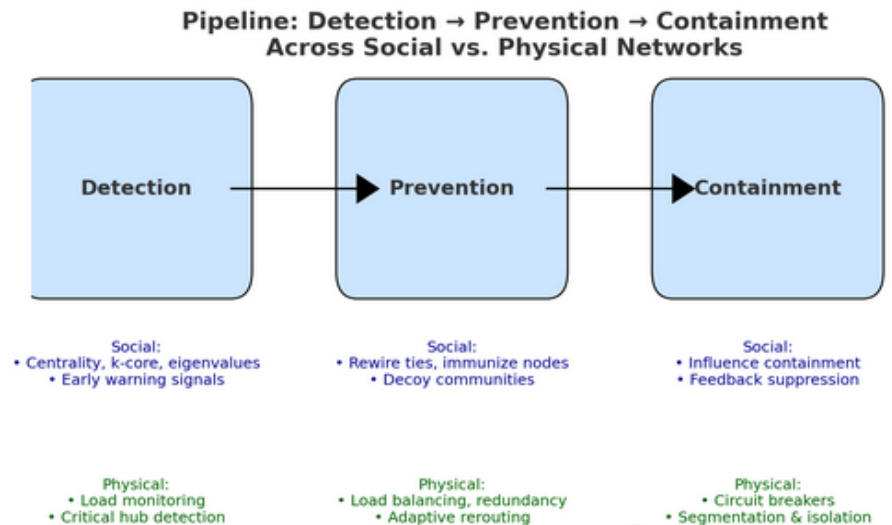
- **Social Networks:** Percolation points are typically opinion leaders or bridge nodes connecting multiple groups.
- **Physical Networks:** They are critical infrastructure hubs or bottleneck links where overload triggers cascades.

The mathematics of percolation is similar, but interventions differ:

- In social systems → information shaping, coalition dilution, influence moderation.
- In physical systems → redundancy, rerouting, controlled shutdowns.

Summary

- Detect early (centrality, eigenvalues, variance)
 - Break coalitions (rewire, immunize, dilute)
- and
- Damp escalation (containment, redundancy, suppression)



The Redefinition of Presence and Participation favoring percolation speed

- What does it mean to be “present” in a digital vs. physical space?
- Passive vs. active participation: does digital presence dilute engagement?
- The shift from physical proximity to synchronous connectivity
- Social rituals replaced by “likes”, emojis, and silent attendance [avatars, personas]
 - Do people feel “together” online the same way they do in person?
 - What behaviors define meaningful participation in each space?
 - How do we notice disengagement in physical vs. digital presence?
- Percolation on positive trends
- Percolation on negative trends
- Mediating percolation thresholds



Intimacy, Trust, and Empathy in Mediated Communication

- The erosion or reshaping of emotional cues (tone, gesture, gaze)
 - Empathy in text and video: how effective are digital surrogates?
 - Trust-building in remote relationships (social, professional, educational)
 - The paradox of online oversharing vs. real-life reticence
-
- Can deep trust and empathy be cultivated through screens?
 - Which aspects of human connection suffer most in digital-only settings?
 - How do people interpret silence or delay differently online vs. in person?



Public Space, Privacy, and Social Boundaries

- Blurring lines between public and private spheres in digital platforms
 - Behavior norms in open vs. digital spaces (e.g., politeness, conflict)
 - “Performative” vs. authentic behavior in public digital settings
 - Surveillance culture and loss of spontaneous, anonymous interaction
-
- Where do we draw the line between public and private in digital contexts?
 - How has surveillance (cameras, screenshots, data traces) changed social risk-taking?
 - Are digital gatherings more “staged” or self-curated than open space ones?



Fragmentation vs. Inclusion in Community Formation

- Echo chambers and affinity bubbles vs. diverse, open spaces
 - How digital tools enable or discourage inclusive public discourse
 - Community building in online vs. neighborhood physical spaces
 - Temporary digital collectives vs. long-standing communal ties
-
- Do digital platforms foster true inclusion, or do they isolate?
 - How do algorithms shape who we gather with online?
 - What's the role of chance encounters in open space that we lose online?



Temporal Rhythms and Attention Span

- Asynchronous interaction vs. real-time social co-presence
 - Impact of notifications, multitasking, and screen fatigue on attention
 - How physical environments shape patience and shared rhythm
 - Digital gatherings and the erosion of ceremony or social pacing
-
- How does the structure of digital space impact our attention spans?
 - Have we lost rituals (e.g., greetings, pauses, closure) in digital gatherings?
 - Does asynchronous communication change how we value responsiveness?

Behavioral Adaptation and Social Learning

- Changing rules of etiquette, silence, turn-taking, and body language
 - Youth and children's social development in screen-first cultures
 - Learning to behave in hybrid gatherings (e.g., Zoom plus in-person)
 - Cross-generational challenges in adapting to digital social norms
-
- Are we teaching different “social skills” to children growing up online?
 - What social habits have you personally had to unlearn or relearn?
 - Can hybrid formats create a new, shared behavioral grammar?



Behavioral changes in social interaction (Digital vs Real)

Topic 1: Q: Presence and Participation

Topic 2: Q: Intimacy, Trust, and Empathy

Topic 3: Q: Public Space vs Privat Space (Social Boundaries)

Topic 4: Q; Small groups vs Large Inclusion

Topic 5: Q: Life pace and Attention

Topic 6: Q: Behavioral Adaptation and Social Learning

Topic 7: Q: Meaning of Gathering Together



In both digital and open spaces

How to be human?

How to listen, connect, disagree, and belong?

What habits should we preserve across both spaces?

What habits must we consciously revisit?

! Digital behavior is recorded and exposed!

! Do not share until the bottom of your pocket!

! Control your temper!

! But do not pretend!