Social Physics: A Predictive Science of Digital Perception

Core Theoretical Framework

Sara Skouri — December 18, 2025

Ontology

- **Percepton** $\varphi_i = (m_i, d_i)$
- $m_i \in [0, 1]$: Intensity
- $d_i \in [-1, 1]$: Stance
- **Agent**: Node with φ_i
- **Edge** $\eta_{i \to j}$: Influence weight

Dynamics

$$\frac{dm_i}{dt} = -d_i m_i \quad \text{(Decay)}$$

$$m_i(t+1) = (1 - d_i)m_i(t) + \sum_j \eta_{j \to i}\, g(m_j, d_j, d_i) + \epsilon_i(t) \quad \text{(Influence)}$$

System Metrics

- P-E-A $= \sqrt{\frac{A_p^2 + A_e^2 + A_b^2 + A_s^2}{4}}$
- $R_{\text{fission}} = \lambda_1(\mathbf{D} + \mathbf{W})$
- $\text{CDT}(X) = \inf\{\alpha \geq 0 \mid \lambda_1(\alpha) \geq 1\}$

Pipeline:

$$\text{P-E-A} \uparrow \Rightarrow \mathbf{W} \uparrow \Rightarrow \lambda_1 \uparrow \Rightarrow \begin{cases} \lambda_1 < 1: & \text{Stable} \\ \lambda_1 > 1: & \text{Social} \end{cases}$$

The Critical Threshold

$$\boxed{\text{CDT} = \text{P-E-A}_{\text{critical}}}$$

- Below CDT: Distortion fades
- Above CDT: Runaway cascades
- Empirically identified in Brexit case study

Empirical Validation

- **Brexit 2016**: CDT ≈ 0.30, crossed May 2016
- **Lab Notes**: Hand-computable network simulations
- **Five Lenses**: Psychology, CS, Political Science, Philosophy, Media Studies

---

Social Physics models digital discourse as a dynamical system where algorithmic amplification (P-E-A) modifies social influence weights, creating predictable tipping points (CDT) beyond which perceptions cascade uncontrollably (Social Fission). The framework is mathematically formalized, empirically validated, and implemented in reproducible simulations.