

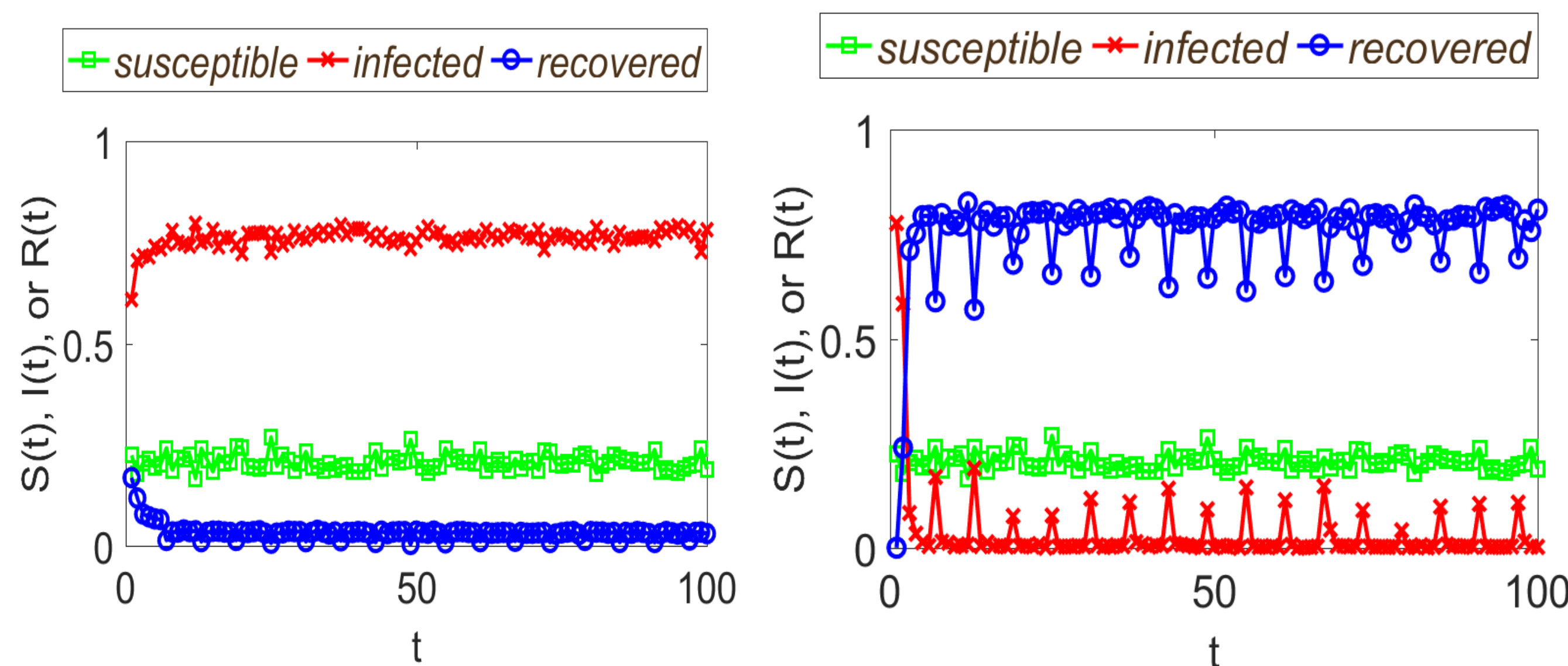
**S&T Campaign: Information Sciences
Networks and Communications**

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Research Objective

- Develop a human agent's opinion model that can make decisions by aggregating evidence under uncertainty where the human agent's thought process is affected by his/her prior belief and like-minded nature
- Model and analyze a human agent's opinion and opinion update model under uncertainty, derived from lack of information or conflicting information
- Identify the key factors affecting the significant mitigation or removal of false information in a human agent's opinion model

Results



Ratio of true vs. false info = 1:5
w/o prior belief/disbelief

Ratio of true vs. false info = 1:5
w/ prior belief/disbelief

Challenges

- There exists significant lack of understanding in formulating a human opinion with uncertain, incomplete, or conflicting evidence
- Subjective Logic (SL) does not consider conflicting evidence as the cause of increasing uncertainty

Discussion & Conclusions

- Unbiased prior belief or disbelief can help enhance decision performance under conflicting evidence
- A small fraction of agents propagating true information with unbiased prior belief/disbelief can significantly help mitigate false information propagation
- A larger number of true information propagators is more effective than the higher frequency of true information propagation

Approach

Opinion in Subjective Logic: a human agent i 's binary opinion is represented by belief, disbelief, and uncertainty, and given by:

$$w_i = \{b_i, d_i, u_i, a_i\}$$

where a_i is the base rate, which normally represents the general background knowledge, called prior belief. The expected belief, E_{b_i} , or expected disbelief, E_{d_i} , are given by

$$E_{b_i} = b_i + a_i u_i, E_{d_i} = d_i + (1 - a_i) u_i$$

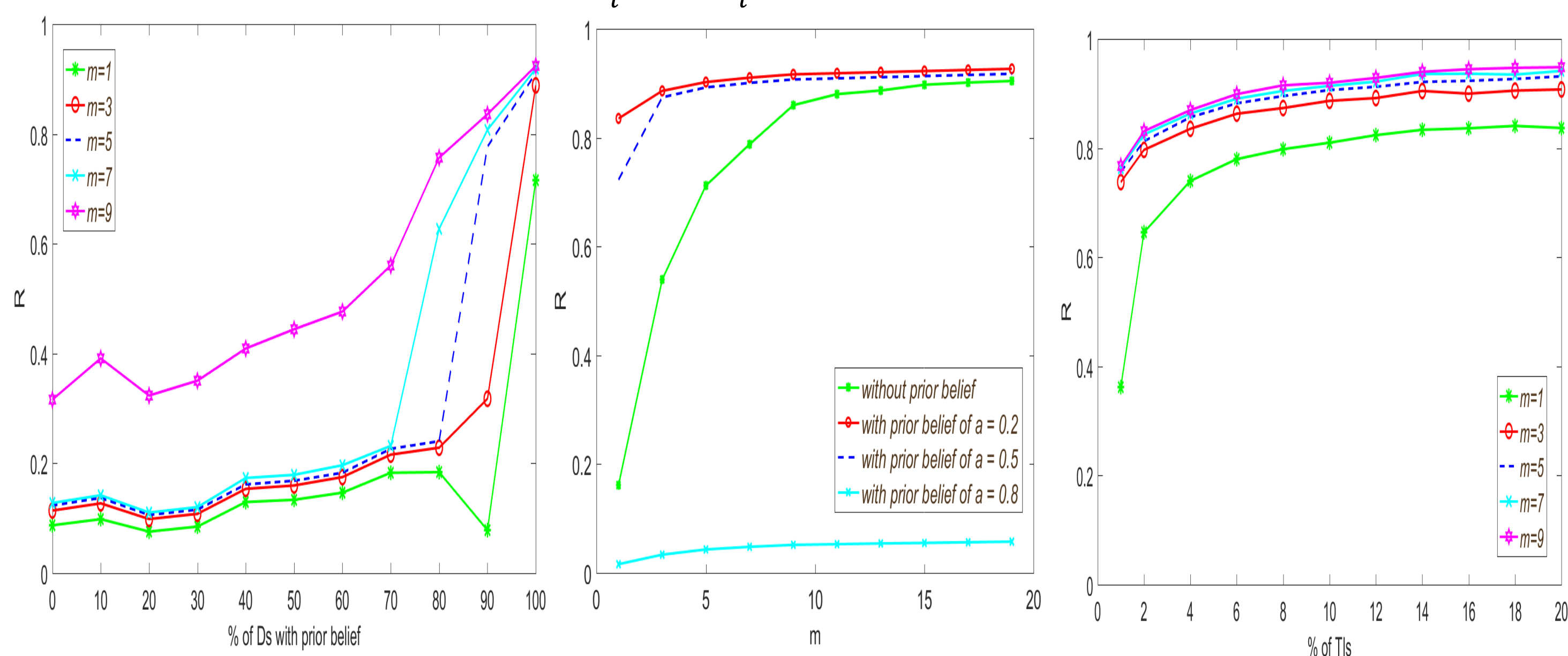
Like-minded opinion consensus based on cosine-similarity based discounting:

$$b_{i \otimes j} = s_i^j b_j, d_{i \otimes j} = s_i^j d_j, u_{i \otimes j} = 1 - s_i^j (1 - u_j)$$

Opinion to deal with ambiguity with prior belief/disbelief:

$$b'_i = c_i b_i, d'_i = c_i d_i, u'_i = 1 - c_i (1 - u_i)$$

$$c_i = \frac{|E_{b_i} - E_{d_i}|}{E_{b_i} - E_{d_i}} = |2b_i + 2a_i u_i - 1|$$



Effect of % of doubters
w/ prior belief

Effect of # of false
info. propagation (m)

Effect of % of true
informers (T_i)

**Complementary Expertise/ Facilities/
Capabilities Sought in Collaboration**

- Expertise in network science & cognitive modeling; knowledge and uncertainty reasoning and decision making

**ARL Facilities and Capabilities Available
to Support Collaborative Research**

- Open Campus program through ORAU summer journeyman internship/faculty programs

Publications

- Accepted to IEEE GLOBECOM, Dec. 2017
- ACM Trans. Social Computing under review, Sept. 2017
- IASTATS 2018 under review, Oct. 2017