

# Soheil Eshghi

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Interests Optimal **dynamic** data-driven decision-making in complex networked systems

## Appointments

- 2018–Current Postdoctoral Associate, **Yale School of Public Health**, New Haven, CT  
With Prof. Forrest Crawford, I work on developing mathematical models to improve vaccination schedules and contact-tracing policies in combating epidemics.
- 2016–2018 Postdoctoral Associate, **Yale Institute for Network Science**, New Haven, CT  
With Prof. Leandros Tassiulas, I developed tools to target strategic interventions in social groups for DAIS ITA and helped write grants to ARL, ARO, and NIH.
- 2015–16 Postdoctoral Associate, **ECE Dept., Cornell University**, Ithaca, NY  
With Profs. Qing Zhao & Lang Tong, I derived optimal coordinated influence control policies for the NS CTA and co-wrote a book on charge scheduling of electric vehicles.
- 2011–15 Research Assistant, **ESE Dept., University of Pennsylvania**, Philadelphia, PA  
Under the supervision of Profs. Saswati Sarkar & Santosh Venkatesh, I conducted research on the optimal control of epidemics, with applications to epidemiology, network security, and delay-tolerant network message delivery.
- Summer 2014 Research Intern, **EM Dept., NEC Labs America (NECLA)**, Cupertino, CA  
With Dr. Rakesh M. Patil, I proposed optimal stochastic smart-grid management policies focused on pricing grid-scale batteries (1 paper, 1 patent application, 1 invention record).

## Education

- 2011–15 PhD **University of Pennsylvania**, *Electrical & Systems Engineering*  
**Thesis: Optimal Control of Epidemics in the Presence of Heterogeneity**  
I showed how heterogeneity affects epidemic spread, and is critical to control efforts.  
Committee: **Saswati Sarkar**, S. Venkatesh, G. Pappas, V. Preciado, O. Milenkovic (UIUC)
- 2011–13 MSc **University of Pennsylvania**, *Electrical Engineering*, .
- 2006–10 BSc **Sharif University of Technology (IRI)**, *Electrical Engineering*

## Selected awards

- Feb. 2017 **Third Place**, *Datahack*, Yale Institute for Network Science, New Haven, CT.
- Mar. 2015 **Runner Up**, *Fels National Public Policy Challenge*, Philadelphia, PA.
- Mar. 2015 **Winner**, *Penn Public Policy Challenge*, Philadelphia, PA.
- Oct. 2010 **PhD Research Fellowship**, *University of Pennsylvania*, Philadelphia, PA.
- Jun. 2006 **Best combined result in Iranian national university entrance exam history:**
- **1<sup>st</sup>/600,000**, Azad Math-Physics, ○ **15<sup>th</sup>/400,000**, National Math-Physics,
  - **1<sup>st</sup>/250,000**, National Foreign Langs.
- This led to awards from Iran's President, and Ministers of Education, and Higher Education, as well as a **scholarship** from the Iranian National Elite Foundation.

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## Teaching certificates

- 2017 **Expressing Your Enthusiasm: an Oral Communication Workshop for STEM Graduate Students and Postdocs**, *Yale University*  
5-workshop series on effectively communicating research to a lay audience
- 2016 **Building Mentoring Skills for an Academic Career**, *Cornell University*  
6-workshop series exploring various aspects of mentoring relationships in academia
- 2014 **Course in College Teaching**, *University of Pennsylvania*  
Set of 10 hands-on teaching workshops focused on active learning and student engagement

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## Teaching assistantships

- Cornell Markov Decision Processes (graduate), Digital Signal Processing
- Penn Fourier Analysis, Digital Signal Processing (graduate)
- Sharif EE Principles, Logic & Analog Circuits, Computer Structure, Microprocessors Lab

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## PhD thesis

- Description I showed how heterogeneity significantly affects the spread of epidemics, and how it should be leveraged to control their spread. I developed a taxonomy of heterogeneity in epidemic spread: heterogeneity can manifest itself in the contact rates (structure) of the network, in the resources available to agents, and in the epidemic itself. For each case, I mathematically modeled a real-world process, validated the model, identified the control mechanisms and constraints, and characterized optimal control strategies for the use of those resources. In each case, I used simulation and real-world trace data to show how the structures I analytically derived can significantly affect the spread and cost of epidemics.

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## Entrepreneurial and volunteer experience

- 2014–16 **Founder and Advisor**, *SmartTrack*, Philadelphia, PA
- As part of a pro-bono student project at the University of Pennsylvania, and in collaboration with stakeholders, I helped develop an app-based solution for managing inventory (e.g., textbooks) for large, low-income school districts such as the School District of Philadelphia.
  - We won the Penn Public Policy Challenge, and placed second nationally (\$5K prize each).
  - Our work has been featured in numerous publications, including *Governing* magazine
  - We were one of 9 out of 300 teams accepted to EDSi accelerator at Penn
  - Our solution is being used in Camden public schools and Philadelphia charter schools
  - We have raised over \$125,000 in total
- 2015–16 **VP of Education**, *Cornell Graduate Consulting Club*, Ithaca, NY
- I created & curated a 7 event series for 12 select participants to improve consulting skills
  - I led a team of 6 students to devise a marketing plan for a local mobile tourism startup
- 2014–15 **Co-chair**, *Penn Graduate Case Competition*, Philadelphia, PA
- I organized the logistics, client selection, case creation, and sponsorship with my team of 5 and MC'ed the event.
  - We out-raised our max cost projections by 110% and increased diversity of participants
  - The winning proposal was implemented by client within 3 months
- 2014 **Convener**, *Penn ESE PhD Student Colloquium*, Philadelphia, PA
- Memberships IEEE (2008–Current), IEEE Control Systems Society (2014–Current)

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## Journal publications

### Published

- [6] Papakostas, D., **Eshghi, S.**, Katsaros, D., Tassiulas, L., *Distributed algorithms for multi-layer connected edge-dominating sets*, Control Systems Letters (L-CSS), 3(1), 31-36.  
**L-CSS-19**
- [5] **Eshghi, S.**, Preciado, V.M., Sarkar, S., Venkatesh, S.S., Zhao, Q., D'Souza, R., Swami, A., *Spread, then Target, and Advertise in Waves: Optimal Budget Allocation Across Advertising Channels*, Trans. on Network Science & Engineering  
**TNSE-18**
- [4] Katsaros, D., Papakostas, D., **Eshghi, S.**, Tassiulas, L., *Energy-efficient backbone formation in military multi-layer ad-hoc networks*, Ad Hoc Networks journal, 81, 17-44.  
**ADHOC-18**
- [3] **Eshghi, S.**, Sarkar, S., Venkatesh, S.S., *Visibility-aware optimal contagion of malware epidemics*, Trans. on Automatic Control, 62(10), 5205-5212.  
**TAC-17**
- [2] **Eshghi, S.**, Khouzani, M., Sarkar, S., Venkatesh, S.S., *Optimal patching in clustered epidemics of malware*, Trans. on Networking , 24(1), 283-298.  
**ToN-16**
- [1] **Eshghi, S.**, Khouzani, M., Sarkar, S., Shroff, N., Venkatesh, S.S., *Optimal energy-aware DTN epidemic routing*, Trans. on Automatic Control , 60(6), 1554-1569.  
**TAC-15**

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## Patents

- [1] Patil, R.M., Sharma, R., **Eshghi, S.**, *Optimal battery pricing and energy management for microgrids*, Patent no. 20160093002, Application no. 14/845412, Pending.

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## Conference publications

### Published (Peer-Reviewed Conferences)

- [13] Papakostas, D., **Eshghi, S.**, Katsaros, D., Tassiulas, L., *Energy-aware distributed edge domination of multilayer networks*, American Control Conference  
**ACC-19**
- [12] **Eshghi, S.**, Maghsudi, S., Restocchi, V., Salisbury, E., Stein, S., Tassiulas, L., *Efficient Influence Maximization Under Partial Network Visibility*, IEEE Infocom Workshop on the Communications and Networking Aspects of Social Networks  
**CAOS-19**
- [11] Papakostas, D., **Eshghi, S.**, Katsaros, D., Tassiulas, L., *Distributed algorithms for multi-layer connected edge-dominating sets*, Conference on Decision and Control  
**CDC-18**
- [10] **Eshghi, S.**, Tassiulas, L., *Whistleblowing games in networks*, Conference on Decision and Control  
**CDC-18**
- [9] **Eshghi, S.**, Tassiulas, L., *Innovation, cheating, and whistleblowing - a game theoretic perspective*, 52nd Annual Conference on Information Sciences and Systems  
**CISS-18**
- [8] Bellamy, R., Colombo, G., **Eshghi, S.**, de Mel, G., Giammanco, C., Morris, R., Rand, D.G., Turner, L.D., Whitaker, R.M., Williams, G.R., *A computational framework for modelling inter-group behaviour using psychological theory*, SPIE Defense + Security  
**SPIE D+S-18**
- [7] **Eshghi, S.**, Williams, G.R., Colombo, G.B., Turner, L.D., Rand, D.G., Whitaker, R.M., Tassiulas, L., *Social group stability and fracture*, 55th Annual Allerton Conference on Communication, Control, and Computing  
**Allerton-17**
- [6] Stein, S., **Eshghi, S.**, Maghsudi, S., Tassiulas, L., Bellamy, R.E., Jennings, N.R., *Heuristic algorithms for influence maximization in partially observable social networks*, International Workshop on Social Influence Analysis  
**SocInf-17**
- [5] **Eshghi, S.**, Williams, G.R., Colombo, G.B., Turner, L.D., Rand, D.G., Whitaker, R.M., Tassiulas, L., *Mathematical models for social group behavior*, Workshop on Dist. Analytics InfraStructure and Algorithms for Multi-Org. Federations  
**DAIS-17**
- [4] Stein, S., **Eshghi, S.**, Maghsudi, S., Tassiulas, L., Bellamy, R.E., Jennings, N.R., *Influence maximisation in partially observable social networks*, Workshop on Dist. Analytics InfraStructure and Algorithms for Multi-Org. Federations  
**DAIS-17**
- [3] Mott, D., Kelley, T., Giammanco, C., **Eshghi, S.**, Zhang, Y., *A framework for modelling the effect of emotion on uncritical reasoning*, Workshop on Knowledge Systems for Coalition Operations  
**KSCO-17**
- [2] **Eshghi, S.**, Patil, R.M., *Optimal battery pricing and energy management for microgrids*, American Control Conference  
**ACC-15**

- [1] Khouzani, M., **Eshghi, S.**, Sarkar, S., Shroff, N., Venkatesh, S.S., *Optimal energy-aware epidemic routing in DTNs*, International Symposium on Mobile Ad Hoc Networking and Computing (**Acceptance rate = 20%**)

### Published (Posters & Invited Conferences)

- [6] Restocchi, V., Brede, M., Stein, S., Hill, L., **Eshghi, S.**, *Dynamic competitive opinion control: theory, simulations, and experiments*, International Conference on Complex Networks and their Applications, Poster
- [5] **Eshghi, S.**, Tassiulas, L., *Efficient dynamic centrality metrics for election advertising - a case study*, Yale Day of Data 2017, Poster
- [4] **Eshghi, S.**, Maghsudi, S., Restocchi, V., Stein, S., Tassiulas, L., *Heuristic algorithms for influence maximization in partially observable social networks*, International Conference on Complex Networks and their Applications, Poster
- [3] **Eshghi, S.**, Preciado, V.M., Sarkar, S., Venkatesh, S.S., Zhao, Q., D'Souza, R., Swami, A., *Spread, then target, and advertise in waves: optimal capital allocation across advertising channels*, Information Theory and Applications Workshop
- [2] **Eshghi, S.**, Sarkar, S., Venkatesh, S.S., *Visibility-aware contagion of malware epidemics*, Information Theory and Applications Workshop
- [1] Khouzani, M., **Eshghi, S.**, Sarkar, S., Venkatesh, S.S., *Optimal patching in clustered epidemics of malware*, Information Theory and Applications Workshop

### Invited talks

#### Dynamic Control of Spreading Processes on Networks

- 2019 ○ **Yale University**, YINS Colloquium

#### Whistleblowing

- 2018 You scratch my back, and (maybe) I'll scratch yours: whistleblowing games on networks  
○ **Yale University**, YINS Summer Seminar

#### Social Influence

- 2018 Decision-making tools for influence propagation in social systems  
○ **University of Michigan**, EECS Dept (Communication & Signal Processing Seminar)  
Social influence maximization: a synthesis  
○ **Yale University**, YINS (Human Nature Lab)
- 2017 Influence in social systems  
○ **Yale University**, YINS Summer Seminar

#### Optimal control of epidemics in the presence of heterogeneity

- 2018 ○ **Yale University**, School of Public Health (Crawford Lab)
- 2016 ○ **Harvard University**, School of Public Health (Ctr for Communicable Disease Dynamics)  
○ **Georgetown University**, Biology Dept (Bansal Lab)  
○ **University of Georgia**, Biology Dept (Rohani Lab)  
○ **Penn State University**, Biology Dept (Ctr for Infectious Disease Dynamics)  
○ **Yale University**, YINS Summer Seminar  
○ **University of Pennsylvania**, ESE Dept (Complex Systems Group)
- 2015 ○ **Cornell University**, ECE Dept
- 2013 ○ **University of Pennsylvania**, ESE PhD Colloquium

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## Selected service

PC Member: ○ AAMAS-2019, AAAI-2019, AAMAS-2018

Reviewer for: **IEEE Transactions on:**

- Automatic Control (TAC)
- Control of Networked Systems (TCNS)
- Inf. Forensics & Security (TIFS)
- Information Theory (T-IT)
- Mobile Computing (TMC)
- Networking (ToN)
- Network Science & Eng. (TNSE)
- Wireless Communications (TWC)

**Other:**

- Automatica
- PLOS Computational Biology
- ASME J. of Dynamic Systems (J-DS)
- IEEE Communication Letters
- IEEE Control Systems Letters (L-CSS)
- IEEE Access
- Social Network Analysis & Mining (Springer)
- Performance Evaluation (Elsevier)

**Conferences:** WiOpt'16, MIM'16, NetSciCom'17, IFAC World Congress'17, CDC '18, CDC '19

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## Selected coursework – graduate

Optimization Optimal Control, Dynamic Programming, Convex Optimization, Adv. Algorithms  
Probability Eng. Probability, Adv. Probability, Stochastic Processes, Random Process Models  
Economics Game Theory, Dynamic Games & Social Learning, Information Theory, Estimation  
Networks Dist. Dynamic Systems, Network Theory, EE Infrastructure, Green Buildings

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## Selected coursework – undergraduate

Control Linear Control Systems, Linear Algebra, Numerical Methods  
Mathematics Engineering Mathematics, Ordinary Differential Equations, Probability  
Signals Speech Processing, Digital Signal Processing & Lab, Signals & Systems  
Coding C++ Programming, Machine Language & Architecture, Microprocessors  
Networks Wireless Communication, Digital Communication & Lab, Traffic Control  
Energy Power Systems Analysis, Electrical Machines (I, II, & Lab), Fields and Waves

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## Computer skills

Proficient: C/C++ • R • MATLAB (Simulink, CVX, GPOPS, DIDO)  
Infrequently: Python • SQL • Java

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## References

### Prof. Saswati Sarkar

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Professor,  
Dept of Electrical & Systems Engineering,  
University of Pennsylvania  
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**Relation: PhD Advisor**

### Prof. Santosh S. Venkatesh

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Associate Professor,  
Dept of Electrical & Systems Engineering,  
University of Pennsylvania  
200 S. 33rd Street, Philadelphia 19104  
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**Relation: PhD Thesis Co-Advisor**

### Prof. Leandros Tassioulas

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John C. Malone Professor & Chair,  
Dept of Electrical Engineering,  
Yale University,  
17 Hillhouse Ave, New Haven CT 06511  
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**Relation: Postdoc Advisor**

### Prof. Victor M. Preciado

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Associate Professor,  
Dept of Electrical & Systems Engineering,  
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200 S. 33rd Street, Philadelphia, PA 19104  
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**Relation: Committee Member, Collaborator**

### Prof. George J. Pappas

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Joseph Moore Professor & Chair,  
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**Relation: Committee Chair**