

# Haifeng Xu

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## RESEARCH INTERESTS

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Artificial Intelligence, Multi-Agent Systems, Algorithmic Game Theory, Machine Learning, the Design and Analysis of Algorithms, Influence Maximization

## EDUCATION

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<b>University of Southern California</b> , Los Angeles, US Ph.D. in Computer Science Advisors: Milind Tambe and Shaddin Dughmi	08/2013 – present
<b>University of Waterloo</b> , Waterloo, Canada MMath in Computational Mathematics Advisor: Hans De Sterck	08/2012 – 08/2013
<b>University of Science &amp; Technology of China</b> , Hefei, China B.Sc. (honours) in Mathematics, School of Gifted Young I was a member of the HUA Loo-Keng Elite Program in Mathematics	08/2008 – 07/2012

## SELECTED HONORS & AWARDS

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- **Google Ph.D. Fellowship** 2017  
One of the three recipients worldwide in the category *Algorithms, Optimizations and Markets*
- **CAMS Prize for Excellence in Research, USC Center for Applied Mathematical Sciences** 2017  
Awarded annually to two PhD students across the university
- **Best Research Assistant Award, Computer Science Department, USC** 2017
- **Best Paper Award, AAMAS Workshop on Security and Multi-agent Systems (SecMas)** 2016  
Paper: Haifeng Xu, *The mysteries of security games: Equilibrium computation becomes combinatorial algorithm design.*
- **Best Student Paper Award, AAMAS** 2016  
Paper: A. Yadav, H. Chan, A. X. Jiang, H. Xu, E. Rice, M. Tambe, *Using social networks to aid homeless shelters: Dynamic influence maximization under uncertainty.*
- **Mathematics Faculty Graduate Award for Academic Excellence, UWaterloo** 2013
- **Shing-Tung Yau College Student Mathematics Contests, China<sup>1</sup>** 2011
  - Silver Medal in Applied Mathematics (**Top 4 in the country**)
  - Bronze Team Medal (**Top 4 teams in the country**)
- **Microsoft Young Fellowship** 2011
- **Meritorious Winner in Mathematical Contest of Modeling (MCM), US** 2011

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<sup>1</sup>A prestigious national contest organized by the famous mathematician Shing-Tung Yau (a winner of Fields Medal and Wolf Prize).

## RESEARCH EXPERIENCE

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- PhD Student, University of Southern California** 09/2013 – present  
Advisors: Milind Tambe and Shaddin Dughmi  
Dissertation: On the role of information in strategic interactions
- Research Intern, Google Research, Mountain View** 06/2016 – 08/2016  
Mentors: Ashwinkumar Badanidiyuru and Kshipra Bhawalkar  
Project: Targeting and strategic signaling in ad auctions [SODA'18]
- Visiting Student, Simons Institute for the Theory of Computing, Berkeley** 10/2015 – 12/2015  
Program: [Economics and Computation](#)  
Project: Signaling in Bayesian Stackelberg games [AAMAS'16]
- Research Intern, Yahoo! Lab, New York Office** 06/2015 – 08/2015  
Mentor: Ruggiero Cavallo  
Project: Equilibrium analysis in Ad auctions with asymmetrically informed bidders
- Graduate Research Assistant, University of Waterloo** 01/2013 – 08/2013  
Advisor: Hans De Sterck  
Project: Hierarchical clustering algorithm design via algebraic multigrid methods [SDATA workshop at WSDM'15]
- Course Member, Foundations of Social Computing, University of Waterloo** 01/2013 – 04/2013  
Instructor: Kate Larson  
Course Project: Improving the efficiency of crowdsourcing contests [AAMAS'14]
- Research Intern, Microsoft Research Asia** 07/2011 – 06/2012  
Mentors: Bin Gao  
Project: Predicting advertiser bidding behaviors in ad auctions [WWW'13]

## PUBLICATIONS

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\*For papers appearing at theoretical CS venues, the author order is alphabetical ( $\alpha$ - $\beta$ ) by convention.

### Rigorously Refereed Journal Articles & Full Conference Papers

- [19]. **Haifeng Xu**, Kai Wang, Phebe Vayanos, Milind Tambe. Strategic Coordination of Human Patrollers and Mobile Sensors with Signaling for Security Games. *Proceedings of the 32th AAAI Conference on Artificial Intelligence (AAAI'18)*.
- [18]. ( $\alpha$ - $\beta$ ) Ashwinkumar Badanidiyuru, Kshipra Bhawalkar, **Haifeng Xu**. Targeting and Signaling in Ad Auctions. *ACM-SIAM Symposium on Discrete Algorithms (SODA'18)*.
- [17]. ( $\alpha$ - $\beta$ ) Shaddin Dughmi, **Haifeng Xu**. Algorithmic Bayesian Persuasion. *SIAM Journal on Computing* (minor revision). [Supercede the STOC'16 paper below.]
- [16]. ( $\alpha$ - $\beta$ ) Shaddin Dughmi, **Haifeng Xu**. Algorithmic Persuasion with No Externalities. *Proceedings of the 18th ACM Conference on Economics and Computation (EC'17)*.
- [15]. **Haifeng Xu\***, Benjamin Ford\*, Fei Fang, Bistra Dilkina, Andrew Plumtpe, Milind Tambe, Margaret Driciru, Fred Wanyama, Aggrey Rwetsiba, Mustapha Nsubaga and Joshua Mabonga. Optimal Patrol Planning for Green Security Games with Black-Box Attackers. *Proceedings of the 8th Conference on Decision and Game Theory for Security (GameSec'17)*. (\*Equal Contributions)

- [14]. Aaron Schlenker, **Haifeng Xu**, Mina Guirguis, Christopher Kiekintveld, Arunesh Sinha, Milind Tambe, Solomon Sonya, Darryl Balderas, Noah Dunstatter. Don't Bury your Head in Warnings: A Game-Theoretic Approach for Intelligent Allocation of Cyber-security Alerts. *Proceedings of the 26th International Joint Conference on Artificial Intelligence (IJCAI'17)*. **Highlighted in the press release opening the IJCAI'17 conference.**
- [13]. ( $\alpha$ - $\beta$ ) Shaddin Dughmi, **Haifeng Xu**. Algorithmic Bayesian Persuasion. *Proceedings of the 48th ACM Symposium on Theory of Computing (STOC'16)*.
- [12]. **Haifeng Xu**. The Mysteries of Security Games: Equilibrium Computation Becomes Combinatorial Algorithm Design. *Proceedings of the 17th ACM Conference on Economics and Computation (EC'16)*.
- [11]. **Haifeng Xu**, Rupert Freeman, Vincent Conitzer, Shaddin Dughmi, Milind Tambe. Signaling in Bayesian Stackelberg Games. *Proceedings of the 15th International Conference on Autonomous Agents and Multiagent Systems (AAMAS'16)*.
- [10]. **Haifeng Xu\***, Long Tran Thanh\*, Nick Jennings. Playing Repeated Security Games with No Prior Knowledge. *Proceedings of the 15th International Conference on Autonomous Agents and Multiagent Systems (AAMAS'16)*. (\*Equal Contributions)
- [9]. Amulya Yadav, Hau Chan, Albert Jiang, **Haifeng Xu**, Eric Rice, Milind Tambe. Using Social Networks to Aid Homeless Shelters: Dynamic Influence Maximization Under Uncertainty. *Proceedings of the 15th International Conference on Autonomous Agents and Multiagent Systems (AAMAS'16)*. **Best student paper award.**
- [8]. **Haifeng Xu**, Albert X. Jiang, Arunesh, Sinha, Zinovi Rabinovich, Shaddin Dughmi, Milind Tambe. Security Games with Information Leakage: Modeling and Computation. *Proceedings of the 24th International Joint Conference on Artificial Intelligence (IJCAI'15)*.
- [7]. Yue Yin, **Haifeng Xu**, Jiarui Gan, Bo An, Albert X. Jiang. Computing Optimal Mixed Strategies for Security Games With Dynamic Payoffs. *Proceedings of the 24th International Joint Conference on Artificial Intelligence (IJCAI'15)*.
- [6]. Zinovi Rabinovich, Albert X. Jiang, Manish Jain, **Haifeng Xu**. Information Disclosure as a Means of Security. *Proceedings of the 14th International Conference on Autonomous Agents and Multiagent Systems (AAMAS'15)*.
- [5]. **Haifeng Xu**, Zinovi Rabinovich, Shaddin Dughmi, Milind Tambe. Exploring Information Asymmetry in Two-Stage Security Games. *Proceedings of the 29th AAAI Conference on Artificial Intelligence (AAAI'15)*.
- [4]. **Haifeng Xu**, Fei Fang, Albert X. Jiang, Vincent Conitzer, Shaddin Dughmi, Milind Tambe. Solving Zero-Sum Security Games in Discretized Spatio-Temporal Domains. *Proceedings of the 28th AAAI Conference on Artificial Intelligence (AAAI'14)*.
- [3]. Leandro Marcolino, **Haifeng Xu**, Albert X. Jiang, Milind Tambe, Emma Bowring. Give a Hard Problem to a Diverse Team: Exploring Large Action Spaces. *Proceedings of the 28th AAAI Conference on Artificial Intelligence (AAAI'14)*.
- [2]. **Haifeng Xu**, Kate Larson. Improving the Efficiency of Crowdsourcing Contests. *Proceedings of the 13th International Conference on Autonomous Agents and Multiagent Systems (AAMAS'14)*.
- [1]. **Haifeng Xu**, Bin Gao, Diyi Yang, Tiejian Liu. Predicting Advertiser Bidding Behaviors in Sponsored Search by Rationality Modeling. *Proceedings of the 22nd International Conference on World Wide Web (WWW'13)*.

## Book Chapters & Magazine Articles

- [3]. Amulya Yadav, Hau Chan, Albert Jiang, **Haifeng Xu**, Eric Rice, Milind Tambe. Using Social Networks to Raise HIV Awareness Among Homeless Youth. *IBM Journal of Research and Development*, 2017.

- [2]. Leandro S. Marcolino, **Haifeng Xu**, David Gerber, Boian Kolev, Samori Price, Evangelos Pantazis, and Milind Tambe. Multi-agent Team Formation for Design Problems. *Coordination, Organizations, Institutions and Norms in Agent Systems XI. Springer-Verlag Lecture Notes in AI*, 2016.
- [1]. Leandro S. Marcolino, **Haifeng Xu**, Albert X. Jiang, Milind Tambe, and Emma Bowring. The Power of Teams that Disagree: Team Formation in Large Action Spaces. *Coordination, Organizations, Institutions and Norms in Agent Systems X. Springer-Verlag Lecture Notes in AI*, 2015.

## Symposium & Workshop Papers

- [8]. A. Schlenker, **H. Xu**, C. Kiekintveld, A. Sinha, M. Tambe, M. Guirguis, S. Sonya, D. Balderas, N. Dunstatter. Don't Bury your Head in Warnings: A Game-Theoretic Approach for Intelligent Allocation of Cyber-security Alerts. *The Algorithmic Game Theory Workshop (AGT) with IJCAI-1017*.
- [7]. **Haifeng Xu**. The Mysteries of Security Games: Equilibrium Computation Becomes Combinatorial Algorithm Design. *The Workshop on Security and Multi-agent Systems (SecMAS) with AAMAS 2016. Best Paper Award*.
- [6]. **Haifeng Xu**, Albert X. Jiang, Arunesh, Sinha, Zinovi Rabinovich, Shaddin Dughmi, Milind Tambe. Security Games with Information Leakage: Modeling and Computation. *The Algorithmic Game Theory Workshop with IJCAI-1015*.
- [5]. **Haifeng Xu**, Zinovi Rabinovich, Shaddin Dughmi, Milind Tambe. Exploring Information Asymmetry in Two-Stage Security Games. *The AAAI Spring Symposium 2015 on Applied Computational Game Theory*.
- [4]. Leandro S. Marcolino, **Haifeng Xu**, David Gerber, Boian Kolev, Samori Price, Evangelos Pantazis, and Milind Tambe. Agent Teams for Design Problems. *The 19th International Workshop on Coordination, Organisations, Institutions and Norms (COIN 2015), May 2015*.
- [3]. **Haifeng Xu**, Hans De Sterck, Geoff Sanders. Fast Multilevel Co-Clustering: Unraveling the Multilevel Overlapping Cluster Structure of Social Network Data. *The Workshop of Scalable Data Analytics: Theory & Application, with the ACM International Conference on Web Search and Data Mining (WSDM), 2015*.
- [2]. **Haifeng Xu**, Fei Fang, Albert X. Jiang, Vincent Conitzer, Shaddin Dughmi, Milind Tambe. Computing Minimax Strategy for Discretized Spatio-Temporal Security Games. *The Workshop on Optimization in Multi-Agent Systems and Distributed Constraint Reasoning (OPTMAS-DCR) at AAMAS 2014*.
- [1]. Leandro Marcolino, **Haifeng Xu**, Albert X. Jiang, Milind Tambe, Emma Bowring. Diverse Teams in Large Action Spaces. *The 17th International Workshop on Coordination, Organisations, Institutions and Norms (COIN 2014) with AAMAS 2014*.

## CONTRIBUTIONS TO DEPLOYED SOFTWARE SYSTEMS

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### ○ Software Assistant for the US Federal Air Marshal Service (FAMS)

To mitigate the harm due to potential insider threat or real-time surveillance, I developed a new algorithm that enhances unpredictability in FAMS scheduling. This algorithm has been integrated into the software that is delivered to FAMS by [Avata Intelligence](#), and is currently under testing for deployment.

### ○ PAWS (Protection Assistant for Wildlife Security)

I have developed a novel algorithm that provides optimal randomized patrol plans against poachers whose behavior is captured via complex machine learning models. My algorithm is being integrated into PAWS, an anti-poaching software system that has been tested in Uganda and Malaysia by multiple conservation agencies, including Wildlife Conservation Society (WCS) and Panthera.

## PATENTS

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- Algorithmic Bayesian Persuasion (with Shaddin Dughmi), 2015  
*US Provisional Application No. 62/137,613*

## INVITED TALKS

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- CMU CyLab, October 2017, *Strategic Coordination of Human Patrollers and Mobile Sensors with Signaling for Security Games*.
- China Theory Week, Shanghai, China, July 2017, *Persuasion Through the Computational Lens*.
- Multiagent Systems Professional Group (MSPG) Online Seminar Series, May 2017, *Algorithmic Persuasion: Theory and Applications*.
- Econ-CS Young Researcher Workshop, Tel Aviv, Israel, January 2017, *Algorithmic Bayesian Persuasion*.
- Caltech, Social and Information Sciences Laboratory (SISL) Seminar Series, October 2016, *Persuasion Through the Computational Lens*.
- Google Research Seminar Series, Mountain View, July 2016, *Algorithmic Bayesian Persuasion*.

## PROFESSIONAL SERVICE

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### (Co-)Chair

- [Workshop on AI for Imperfect Information Games](#) with AAAI 2018.
- [Workshop on Adversarial Reasoning in Multi-Agent Systems](#) with AAMAS 2017.

### Conference Program Committee

- AAAI (2018)
- IJCAI (2015, 2016, 2017)

### Journal Reviewing Activities

- JAIR (2017)
- JAAMAS (2017)

### Conference Reviewing Activities

STOC (2017), FOCS (2016), SODA (2018, 2015), AAAI (2015), AAMAS (2016), ICALP (2017), ITCS (2018).

## TEACHING & MENTORING EXPERIENCE

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### Teaching Assistant for

- CSCI 675, Convex and Combinatorial Optimization, USC Fall'16
- CSCI 270, Introduction to Algorithms and the Theory of Computing, USC Spring'16  
\* I served as the **head TA** for a team with 6 teaching assistants.
- MATH 138, Calculus II For Honours Mathematics, UWaterloo Winter'13
- MATH 116, Calculus I For Engineering, UWaterloo Fall'12

## Guest Lecture for

- ISE 599, Security and Game Theory, USC Spring'16
  - Lecture 1: *Security Games and Combinatorial Algorithm Design*
  - Lecture 2: *Information Leakage in Security Games*
- CSCI 270, Introduction to Algorithms and the Theory of Computing, USC Spring'16
  - Lecture 1: *Reductions among NP-Complete Problems*

## Mentoring

- **Kai Wang:** *Strategic Coordination of Human Patrollers and Mobile Sensors for Security Games*, Fall 2017.
- **Sarah Cooney:** *Adversary Behavior Modeling in Security Games with Deception*, Fall 2017.
- **Venil Loyd Noronha:** *Mitigating Harms of Information Leakage in Security Games*, Spring 2017.

## GRANT PROPOSAL ASSISTANCE

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- *Security Games on Uncharted Social Networks: Addressing Challenges of Simultaneous Learning and Gameplay*, approx. \$ 500,000 (funded), Army Research Office.
- *Towards OPTimized SEcurity at Ports of Entry (TOP-SEC)*, NSF.

## CONFERENCE/WORKSHOP TALKS

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- GameSec 2017, Vienna, Austria, October 2017. *Optimal Patrol Planning for Green Security Games with Black-Box Attackers.*
- ACM EC 2017, Boston, June 2017. *Algorithmic Persuasion with No Externalities.*
- Google Research, Mountain View, August 2016. *Re-targeting and Signaling in Ad Auctions.*
- STOC 2016, Boston, June 2016. *Algorithmic Bayesian Persuasion.*
- Southern California Symposium on Network Economics and Game Theory, October 2015. *Algorithmic Bayesian Persuasion.*
- ACM EC 2016, Maastricht, Netherlands, July 2016. *The Mysteries of Security Games: Equilibrium Computation Becomes Combinatorial Algorithm Design.*
- MURI Annual Meeting: Scalable, Stochastic and Spatio-temporal Game Theory for Real-World Human Adversarial Behavior, Los Angeles, CA, USA, September 2016. *The Mysteries of Security Games: Equilibrium Computation Becomes Combinatorial Algorithm Design.*
- AAMAS workshop on Security and Multi-agent Systems (SecMAS), Singapore, May 2016. *The Mysteries of Security Games: Equilibrium Computation Becomes Combinatorial Algorithm Design.*
- AAMAS 2016, Singapore, May 2016. *Playing Security Games With No Prior Knowledge.*
- AAMAS 2016, Singapore, May 2016. *Signaling in Bayesian Stackelberg Games.*
- MURI Annual Meeting: Scalable, Stochastic and Spatio-temporal Game Theory for Real-World Human Adversarial Behavior, Los Angeles, CA, USA, September 2015. *Signaling in Bayesian Stackelberg Games.*
- Yahoo! Lab Science Week, San Francisco, July, 2015. *On Information Asymmetry in Second Price Auctions.*
- The 24th International Joint Conference on Artificial Intelligence (IJCAI), Argentina, 2015. *Security Games with Information Leakage: Modeling and Computation.*

- Algorithmic Game Theory workshop with IJCAI 2015. *Security Games with Information Leakage: Modeling and Computation*.
- The 29<sup>th</sup> AAAI Conference on Artificial Intelligence (AAAI), Austin, USA, 2015. *Exploring Information Asymmetry in Two-Stage Security Games*.
- AAAI 2015 Spring Symposium, Stanford, March, 2015. *Exploring Information Asymmetry in Two-Stage Security Games*.
- MURI Annual Meeting: Scalable, Stochastic and Spatio-temporal Game Theory for Real-World Human Adversarial Behavior, Los Angeles, CA, USA, December 2014. *Solving Zero-Sum Security Games in Spatio-Temporal Domains*.
- The 13<sup>th</sup> International Conference on Autonomous Agents and Multiagent System (AAMAS), Paris, France, 2014. *Improving the Efficiency of Crowdsourcing Contests*.
- International Joint Workshop on Optimization in Multi-Agent Systems and Distributed Constraint Reasoning (OPTMAS-DCR), at AAMAS 2014. *Computing Minimax Strategy for Discretized Spatio-Temporal Zero-Sum Security Games*.

## REFERENCES

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### **Milind Tambe**

Helen N. and Emmett H. Jones Professor in Engineering  
Professor, Computer Science & Industrial and Systems Engineering Departments  
University of Southern California  
tambe@usc.edu

### **Shaddin Dughmi**

Assistant Professor, Computer Science Department  
University of Southern California  
shaddin@usc.edu

### **Vincent Conitzer**

Kimberly J. Jenkins University Professor of New Technologies  
Professor, Computer Science, Economics and Philosophy Departments  
Duke University  
conitzer@cs.duke.edu

### **Ariel Procaccia**

Associate Professor, Computer Science Department  
Carnegie Mellon University  
arielpro@cs.cmu.edu