David Teh-Hwa Kao

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Professional Interests

Prototyping and algorithm design in signal processing, communication networks, & machine learning; Statistics & network information theory.

Education

Ph.D.	Electrical Engineering	Rice University — 2012
M.S.	Electrical Engineering	Rice University — 2008
B.S. (with honors)	Electrical Engineering	Univ. of Illinois at Urbana-Champaign — 2006

Professional Experience

R&D Postdoc. Associate **Pixels.IO** MAR 2015 – Present

Communication systems R&D: Developed test procedures and new schemes for video response (VR) codes, specifically focusing on quantitatively developing signal overlay techniques that create a screen-to-mobile-device communication link which remains unobtrusive (invisible) to the human observing the original video content.

Postdoc. Researcher **Univ. Southern California – EE Department** MAR 2014 – FEB 2015

Network information theory research (*continuation of prior (Cornell) position*): Developed new schemes to represent/store/transmit data that outperform the state of the art in a broad range of settings including:

- content-caching device networks,
- device-to-device communication networks,
- wireless (interference) networks,
- 5G communications.

Developed new analytical tools to bound fundamental limits of performance for each setting, which confirm that in certain cases the new schemes are in fact optimal.

Postdoc. Researcher **Cornell Univ. – ECE Department** FEB 2013 – FEB 2014

Network information theory research (*please see above*).

Research Assistant **Rice Univ. – ECE Department (CMC Lab)** AUG 2006 – DEC 2012

Network information theory research: Studied fundamental limits of communication and interference management in wireless networks with distributed and mismatched knowledge of the network/channel state: 1) proved that in even in networks with a small number of users, existing approaches can be optimal if transmitters are not given "enough" channel knowledge, and 2) identified for each transmitter the critical amount of "enough" channel knowledge needed to exploit sophisticated interference management techniques.
[Thesis: A Matter of Perspective: Reliable Communication and Coping with Interference with Only Local Views]

Operations research: Used graph-, game-, and optimization-theoretic tools to study the impact of information asymmetry in resource allocation problems, with a specific application to dynamic spectrum allocation in wireless networks. Constructed distributed schemes to optimize usage of limited spectrum and analyzed the impact of locally-limited interaction on fairness of allocations.
[Thesis : On Fairness in Wireless Networks Under Channel Uncertainty]

Course assistant: Assisted in administration, grading, and instruction of numerous courses including Signals and Systems, Digital Communications, & Wireless Communications

Visiting Researcher **Arizona State Univ. – School of Arts, Media & Eng.** Summer 2010
Social media research: Studied the interplay between user devices, communication network infrastructure, and spread of information in social networks. Developed scripts to gather sample social network data (Twitter) and created statistical models for subsequent analyses. Assisted in composition of grant proposal.

Visiting Researcher **Princeton Univ. – EE Department** Summer 2008
Operations research: Developed axiomatic system of measuring "fairness" which generalizes many mathematical notions of fairness and social optimality in engineering, economics, social sciences, and philosophy. Consequently, this system of axioms quantifying prevalent socio-psychological themes across many disciplines.

Engineering Intern **Motorola Customer's Center for Solutions Integration** Summer 2006
Designed, staged, and tested new large scale, two-way trunking radio systems for first responders. Integrated new systems with previously deployed systems. Demonstrated and guided clients through various system features.

Honors & Awards

Edmund McAshan Dupree Distinguished Graduate Fellowship in Electrical Engineering (2008),
Texas Instruments Distinguished Fellowship (2006), Alton B. Zerby & Carl T. Koerner Award Finalist(2007),
Vodafone Research Scholarship (2005), University of Illinois Chancellor's Scholar (2002),
University of Illinois Outstanding ECE Freshman (2002), National Merit Finalist (2002),
Brown University Book Award (2002), Hillsborough High School Mathematics Award (2002), Hillsborough High School Valedictorian (2002)

Publications

[1] D. Kao, M. Maddah-Ali, and A. Avestimehr, "Blind index coding." to be submitted to Information Theory, IEEE Transactions on.

[2] S. Li, D. Kao, and A. Avestimehr, "Rover-to-orbiter communication in mars: Taking advantage of the varying topology." to be submitted to Communications, IEEE Transactions on.

[3] D. Kao, M. Maddah-Ali, and A. Avestimehr, "Blind index coding." submitted to Information Theory (ISIT), 2015 IEEE International Symposium on.

[4] S. Li, D. Kao, and A. Avestimehr, "Rover-to-orbiter communication in mars: Taking advantage of the varying topology." submitted to Information Theory (ISIT), 2015 IEEE International Symposium on.

[5] D. Kao, M. Maddah-Ali, and A. Avestimehr, "Blind index coding over wireless channels: The value of repetition coding." to appear in proceedings of Communications (ICC), 2015 IEEE International Conference on.

[6] N. Naderializadeh, D. Kao, and A. Avestimehr, "How to utilize caching to improve spectral efficiency in device-to-device wireless networks," in *Communication, Control, and Computing (Allerton), 2014 52nd Annual Allerton Conference on*, Oct 2014.

[7] D. Kao and A. Avestimehr, "Linear degrees of freedom of the MIMO X-channel with delayed CSIT." submitted to Information Theory, IEEE Transactions on.

[8] D. Kao, M. Maddah-Ali, and A. Avestimehr, "Align-and-forward relaying for two-hop erasure broadcast channels," in *Information Theory (ISIT), 2014 IEEE International Symposium on*, pp. 1932–1936, June 2014.

[9] D. Kao and A. Avestimehr, "Linear degrees of freedom of the mimo x-channel with delayed csit," in *Information Theory (ISIT), 2014 IEEE International Symposium on*, pp. 366–370, June 2014.

[10] D. Kao and A. Sabharwal, "Two-user interference channels with local views: On capacity regions of TDM-dominating policies," *Information Theory, IEEE Transactions on*, vol. 59, no. 11, pp. 7014–7040, 2013.

[11] D. Kao, "How local can a node's view be and still guarantee sum-capacity in interference networks?," in *Global Conference on Signal and Information Processing (GlobalSIP), 2013 IEEE*, pp. 337–340, Dec 2013.

[12] D. Kao and A. Sabharwal, "An upper bound on the capacity of vector dirty paper with unknown spin and stretch," in *Information Theory Proceedings (ISIT), 2013 IEEE International Symposium on*, pp. 281–285, 2013.

[13] D. Kao and A. Sabharwal, "Node cooperation with local views in the two-user interference channel," in *Signals, Systems and Computers (ASILOMAR), 2012 Conference Record of the Forty Sixth Asilomar Conference on*, pp. 1748–1752, Nov 2012.

[14] H. Yu, L. Zhong, A. Sabharwal, and D. Kao, "Beamforming on mobile devices: A first study," in *Proc. ACM Int. Conf. Mobile Computing and Networking (MobiCom)*, 2011.

[15] T. Lan, D. Kao, M. Chiang, and A. Sabharwal, "An axiomatic theory of fairness in wireless resource allocation," in *Proc. IEEE INFOCOM Conference*, 2010.

[16] D. T.-H. Kao and A. Sabharwal, "Impact of network topology knowledge on fairness: A geometric approach," in *Proc. IEEE INFOCOM Mini-Conference*, 2009.

Posters, Presentations, & Demos

[1] D. Kao and A. Sabharwal, "On capacity regions of interference channels with mismatched local views." North American School of Information Theory. Cornell University, Ithaca NY, June 2012.

[2] D. T. H. Kao and A. Sabharwal, "On capacity regions of interference channels with mismatched local views." The Winedale Workshop. Round Top TX, October 2011.

[3] H. Yu, L. Zhong, A. Sabharwal, and D. Kao, "Beamforming on mobile devices: A first study." MobiCom Demonstration. 2011.

[4] D. Kao and A. Sabharwal, "Simple approaches can optimize scalable interference networks." ACM S3 Workshop. 2011.

[5] D. T. H. Kao and A. Sabharwal, "When can a distributed interference network do better than tdma?." NYU-Polytechnic Institute. New York NY, June 2011.

[6] D. T. H. Kao and A. Sabharwal, "On capacity regions of interference channels with mismatched local views." AT&T Labs. Florham Park NJ, June 2011.

[7] D. T. H. Kao and A. Sabharwal, "On capacity regions of interference channels with mismatched local views." Rutgers WINLAB. New Brunswick NJ, June 2011.

[8] D. T. Kao and A. Sabharwal, "Coping with interference in wireless networks with only local views." Princeton EDGE Lab. Princeton NJ, May 2011.

[9] D. T. Kao and A. Sabharwal, "Impact of network topology knowledge on fairness: A geometric approach." 2nd Annual School of Information Theory. Chicago IL, August 2009.

[10] D. T. Kao and A. Sabharwal, "Impact of network topology knowledge on fairness: A geometric approach." The Winedale Workshop. Round Top TX, October 2008.

[11] D. T. Kao and A. Sabharwal, "Distributed spectrum sharing via graph coloring." Communications Theory Workshop. Sedona AZ, May 2007.

Course Projects

"Rate-compatible Irregular LDPC code design for HARQ Systems with Rate Limited Feedback"
ELEC 541 — Fall 2008, with Debashis Dash **TI Best Coders (best class project)**
"Cooperation-Enabled Virtual MIMO for High-Throughput Cellular Downlink"
ELEC 433 — Fall 2008, with Michael Wu
"On Distributed Optimization in Wireless Networks: Utility Definition and Information Sharing"
ELEC 537 — Fall 2007, with Gareth Middleton

Selected Languages, Tools, & Platforms

- ◇ C, C++, Python, LaTeX, Matlab, NS2, NumPy/SciPy, Scikit-Learn, WARP
- ◇ Professional proficiency in spoken/written German, spoken Chinese (Mandarin)

Activities

Brown School of Engineering, Rice University:
- Presentation Coach 2009–2012

ECE Department, Rice University:
- Mentor for First-year Graduate Students 2009–2010
- Graduate Student Recruitment Coordinator 2007–2009

Eta Kappa Nu (Electrical and Computer Engineering Honor Society):
- Alpha Chapter President 2005–2006
  - (Outstanding Chapter Award) 2006, 2007
- Centennial Conference Programming Committee 2004

Tau Beta Pi (Engineering Honor Society)

Institute of Electrical and Electronics Engineers (IEEE):
- Member of Communications Society & Information Theory Society

Runner and Triathlete (10+ Marathons, Ironman Triathlon)

References

Available upon request