

M. Salman Asif

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RESEARCH INTERESTS

Machine learning and information processing: Fast and efficient algorithms for data representation, estimation, and organization.

Computational imaging: Design and implementation of novel imaging systems that exploit static and dynamic structures in images and videos.

Compressive sensing: Theory and methods for (compressed) data acquisition and reconstruction.

EDUCATION

Georgia Institute of Technology, Atlanta, Georgia

Ph.D. in Electrical and Computer Engineering August 2013

Advisor: Justin Romberg

Thesis: "Dynamic compressive sensing: Sparse recovery algorithms for streaming signals and videos"

M.S. in Electrical and Computer Engineering August 2008

Advisor: Justin Romberg

Thesis: "Primal dual pursuit: A homotopy based algorithm for the Dantzig selector"

University of Engineering & Technology, Lahore, Pakistan

B.Sc. in Electrical Engineering (*with Honors*) December 2004

Rank: 2nd in a class of 275

PROFESSIONAL EXPERIENCE

University of California, Riverside

Riverside, California

Assistant Professor

July 2016 – Present

Rice University

Houston, Texas

Postdoctoral Research Associate

February 2014 – June 2016

- Working on mathematical models and algorithms for data analysis, sensing, and recovery for novel applications in signal processing, machine learning, and computational imaging.
- Recent projects include design and implementation of a lens-free imaging system, biconvex algorithms for phase retrieval and blind deconvolution, and adaptive sensing with structure-preserving embedding.

Samsung Research America

Richardson, Texas

Senior Research Engineer

August 2012 – January 2014

- Worked on computational imaging and applications for lightfield and multiview cameras.
- Worked on super-resolution and sparse representation schemes for image and video processing.
- Proposed novel applications of compressive sensing for medical imaging modalities, such as MRI, ultrasound, and computed tomography.

Georgia Institute of Technology

Atlanta, Georgia

Graduate Research Assistant

January 2007 – August 2012

- Worked on dynamic updating algorithms for various ℓ_1 -norm problems. For instance, an ℓ_1 -regularized Kalman filter, sparse streaming signals with overlapping measurements, dictionary learning and updating, and reweighted ℓ_1 -norm minimization.
- Worked on two projects related to the recovery of video signals from underdetermined systems: 1) Low-complexity video compression. 2) Accelerated dynamic MRI.

- Other projects include blind deconvolution of sparse channels and low-rank matrix recovery, and performance analysis of the LASSO and the Dantzig selector homotopy algorithms.

Samsung Research America

Richardson, Texas

Research Intern

May 2010 – August 2010

- Worked on a low-complexity video compression framework using compressive sensing principles. The proposed encoder compresses a video by recording linear projections of each frame. The decoder exploits spatial and temporal structures using inter-frame motion.

Mitsubishi Electric Research Laboratories

Cambridge, Massachusetts

Research Intern

May 2009 – August 2009

- Worked on the development of a compressive sensing framework for streaming signals with causal measurements and a greedy matching pursuit algorithm with computational guarantees.
- Worked on a recovery algorithm for streaming, high-speed videos with coded-exposure imaging.

University of Engineering and Technology (UET)

Lahore, Pakistan

Lecturer

January 2005 – August 2006

- Worked as a lecturer in the Electrical Engineering Department.
- Taught introductory undergraduate courses and served as laboratory instructor.

JOURNAL
PUBLICATIONS

- J1. **M. Asif**, A. Ayremlou, A. Sankaranarayanan, A. Veeraraghavan, and R. Baraniuk, "FlatCam: Thin, bare-sensor cameras using coded aperture and computation," *IEEE Trans. on Computational Imaging*, 3 (3) pp. 384 – 397, September 2017.
- J2. V. Boominathan, J. Adams, **M. Asif**, B. Avants, J. Robinson, R. Baraniuk, A. Sankaranarayanan, and A. Veeraraghavan, "Lensless Imaging: A computational renaissance," *IEEE Signal Processing Magazine*, 33 (5), pp. 23–35, September 2016.
- J3. J. Holloway, **M. Asif**, M. Sharma, N. Matsuda, R. Horstmeyer, O. Cossairt, and A. Veeraraghavan, "Toward long distance, sub-diffraction imaging using coherent camera arrays," *IEEE Trans. on Computational Imaging*, 2 (3) pp. 251–265, September 2016.
- J4. **M. Asif** and J. Romberg, "Sparse recovery of streaming signals using ℓ_1 -homotopy," *IEEE Trans. on Signal Processing*, 62 (16) pp. 4209–4223, August 2014.
- J5. **M. Asif** and J. Romberg, "Fast and accurate algorithms for reweighted ℓ_1 -norm minimization," *IEEE Trans. on Signal Processing*, 61 (2) pp. 5905–5916, December 2013.
- J6. **M. Asif**, L. Hamilton, M. Brummer, and J. Romberg, "Motion-adaptive spatio-temporal regularization (MASTeR) for accelerated dynamic MRI," *Magnetic Resonance in Medicine*, 70(3) pp. 800–812, September 2013.
- J7. **M. Asif** and J. Romberg, "Dynamic updating for ℓ_1 minimization," *IEEE Journal of Selected Topics in Signal Processing*, 4(2) pp. 421–434, April 2010.

CONFERENCE
PUBLICATIONS

- C1. **M. Asif**, "Low-rank matrix recovery of dynamic events," *GlobalSIP*, Montreal, Canada, November 2017.
- C2. **M. Asif**, "Toward depth estimation using mask-based lensless cameras," *Asilomar Conf. on Signals, Systems, and Computers*, Pacific Grove, California, November 2017.
- C3. **M. Asif**, Ali Ayremlou, Aswin Sankaranarayanan, Ashok Veeraraghavan, and Richard Baraniuk, "FlatCam: Replacing lenses with masks and computation," *Extreme Imaging Workshop, International Conference on Computer Vision (ICCV)*, Santiago, Chile, December 2015.
- C4. **M. Asif**, J Romberg, and R Baraniuk, "Calibration-free accelerated dynamic MRI based on low-rank matrix recovery," *Signal Processing with Adaptive Sparse Structured Representations (SPARS) Workshop*, Cambridge, UK, July 2015.

- C5. H. Chen, **M. Asif**, A. Sankaranarayanan, and A. Veeraraghavan, "FPA-CS: Focal plane array-based compressive imaging in short-wave infrared," in *Proc. Computer Vision and Pattern Recognition (CVPR)*, Boston, Massachusetts, June 2015.
- C6. **M. Asif**, F. Fernandes, and J. Romberg, "Low-complexity video compression and compressive sensing," *Asilomar Conf. on Signals, Systems, and Computers*, Pacific Grove, California, November 2013.
- C7. **M. Asif**, A. Charles, J. Romberg, and C. Rozell, "Estimating and dynamic updating of time-varying signals with sparse variations," in *Proc. IEEE Int. Conf. on Acoustics, Speech, and Signal Processing (ICASSP)*, Prague, Czech Republic, May 2011.
- C8. A. Charles, **M. Asif**, J. Romberg, and C. Rozell, "Sparse penalties in dynamical system estimation," *Conference on Inf. Sciences and Systems (CISS)*, Baltimore, Maryland, March 2011.
- C9. **M. Asif** and J. Romberg, "Sparse signal recovery and dynamic update of the underdetermined system," *Asilomar Conf. on Signals, Systems, and Computers*, Pacific Grove, California, November 2010.
- C10. P. Boufounos and **M. Asif**, "Compressive sensing for streaming signals using the streaming greedy pursuit," in *Proc. Military Commun. Conf. (MILCOM)*, San Jose, California, October 2010.
- C11. **M. Asif**, D. Reddy, P. Boufounos, and A. Veeraraghavan, "Streaming compressive sensing for high-speed periodic videos," in *Proc. IEEE Int. Conf. on Image Processing (ICIP)*, Hong Kong, September 2010.
- C12. **M. Asif** and J. Romberg, "On the LASSO and Dantzig selector equivalence," *Conference on inf. sciences and systems (CISS)*, Princeton, New Jersey, March 2010.
- C13. P. Boufounos and **M. Asif**, "Compressive sampling for streaming signals with sparse frequency content," *Conference on Inf. Sciences and Systems (CISS)*, Princeton, New Jersey, March 2010.
- C14. **M. Asif** and Justin Romberg, "Basis pursuit with sequential measurements and time-varying signals," in *Proc. Computational Advances in Multi-Sensor Adaptive Processing (CAMSAP)*, Aruba, December 2009.
- C15. **M. Asif**, W. Mantzel, and J. Romberg, "Random channel coding and blind deconvolution," *Allerton Conf. on Communication, Control, and Computing*, Monticello, Illinois, October 2009.
- C16. **M. Asif**, W. Mantzel, and J. Romberg, "Channel protection: Random coding meets sparse channels," *Information Theory Workshop*, Taormina, Italy, October 2009.
- C17. **M. Asif** and J. Romberg, "Dynamic updating for sparse time-varying signals," *Conference on inf. sciences and systems (CISS)*, Baltimore, Maryland, March 2009.
- C18. **M. Asif** and J. Romberg, "Dantzig selector homotopy with dynamic measurements," *IS&T/SPIE Computational Imaging VII*, San Jose, CA, February 2009.
- C19. **M. Asif** and J. Romberg, "Streaming measurements in compressive sensing: ℓ_1 Filtering," *Asilomar Conf. on Signals, Systems, and Computers*, Pacific Grove, California, October 2008.

PATENTS

- F. Fernandes, E. Faramarzi, **M. Asif**, and Z. Ma. "Method and system for providing super-resolution of quantized images and video," U.S. Patent App. No. 14/085,486. November 2013.
- F. Fernandes and **M. Asif**, "Method and apparatus for a video codec with low complexity encoding," U.S. Patent App. No. 13/217,100. August 2011.
- P. Boufounos and **M. Asif**, "Method for reconstructing sparse streaming signals using greedy search," U.S. Patent No. 8,204,718. June 2012.

SOFTWARE
PACKAGES

- ℓ_1 **Homotopy**: A collection of MATLAB routines for dynamic updating of various ℓ_1 problems using homotopy. Available at <http://users.ece.gatech.edu/~sasif/homotopy>
- **Dynamic MRI**: MATLAB implementation of motion-adaptive spatio-temporal regularization (MASTeR), which can be used to recover dynamic MR images from highly undersampled k -space data. Available at <http://users.ece.gatech.edu/~sasif/dynamicMRI>
- **VideoCS**: A MATLAB package accompanying low-complexity video compression papers, which includes forward and adjoint operators for orthogonal, biorthogonal, and complex wavelets, and the code for estimating inter-frame motion using the phases of complex wavelet coefficients. Available at <http://www.ece.rice.edu/~ma54/>

HONORS AND
AWARDS

- UC Regents' Faculty Fellowship/Faculty Development Award 2017
- Hershel M. Rich Outstanding Invention Award, Rice University 2016
- Outstanding Service Award 2011
Center for Signal and Image Processing, Georgia Tech
- Merit scholarship, University of Engineering and Technology, Lahore 2001 – 2004
(*awarded to top 5 students every academic year*)
- Merit certificate for the Second overall position in 2001 Electrical Engineering Session 2004
University of Engineering and Technology, Lahore
(*2nd in a class of 275*)

TEACHING
EXPERIENCE

University of California, Riverside

Riverside, California

June 2016 – Present

EE 152: Digital Image Processing, *Fall 2016*

EE 240: Pattern Recognition, *Spring 2017*

PROFESSIONAL
SERVICES

Journal reviews: IEEE Transactions on Signal Processing
IEEE Transactions on Image Processing
IEEE Transactions on Information Theory
IEEE Journal on Special Topics in Signal Processing
IEEE Transactions on Medical Imaging
IEEE Transactions on Biomedical Engineering
IEEE Signal Processing Letters
IEEE Transactions on Aerospace and Electronic Systems
IEEE Transactions on Circuits and Systems for Video Technology
Applied and Computational Harmonic Analysis
ACM Transactions on Mathematical Software
Elsevier Journal on Digital Signal Processing
Springer Machine Vision and Applications.

Conference reviews: International Conference on Computational Photography (ICCP) 2015–2018
Conference on Computer Vision and Pattern Recognition (CVPR) 2017–2018
International Conference on Computer Vision (ICCV) 2017
International Symposium on Information Theory (ISIT) 2013, 2015
European Signal Processing Conference (EUSIPCO) 2013

REFERENCES

Available on request