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CONTACT INFORMATION	Extreme Computing Research Center Division of Computer, Electrical and Mathematical Sciences and Engineering (CEMSE) Al Khwarizmi Bldg 1, Level 4, Desert Side, Room - 4335 CU 03 King Abdullah University of Science and Technology (KAUST), Thuwal 23955-6900, Kingdom of Saudi Arabia	+966 (56) 5005445 (Mobile Phone) +966(012) 802 7319 (Phone) aritra.dutta@kaust.edu.sa www.aritradutta.com
CURRENT AFFILIATION	Postdoctoral Fellow, Extreme Computing Research Center, Division of Computer, Electrical and Mathematical Sciences & Engineering, <i>King Abdullah University of Science and Technology</i> (KAUST), <i>Saudi Arabia</i> , June 2019 to present. Host: Prof. Panagiotis Kalnis.	
DEGREES	Ph.D. in Mathematics, Fall 2016, GPA 3.579, <i>University of Central Florida</i> . Dissertation: Weighted Low Rank Approximation of Matrices: Some Analytical and Numerical Aspects. Ph.D. Advisor: Prof. Xin Li, Co-Advisor: Prof. Qiyu Sun. <i>Winner of Outstanding Dissertation Award 2016 from the mathematics department.</i> <i>Winner of Lee H. Armstrong award for excellence in Graduate teaching, 2017.</i>	
	M.S. in Mathematical Science, Fall 2011, GPA 3.528, <i>University of Central Florida</i> .	
	M.S. in Mathematics and Computing, 2008, GPA 7.22 (10 scale, First Class), <i>Indian Institute of Technology, Dhanbad</i> . Dissertation: Two Square and Two Cube Factorial Experiments. Advisor: Prof. G. N. Singh.	
	B.S. in Mathematics (Hons.), Minor in Physics and Statistics, 2006, <i>Presidency College, Calcutta University</i> .	
RESEARCH INTERESTS	Weighted and Structured Low-Rank Matrix Approximation, Compressive Sensing, Distributed Computing, Convex Optimization, Machine Learning, Deep Learning, Stochastic Optimization, Numerical Analysis, Linear Algebra, Applications in Dimensionality Reduction of Big Data, Sparse Representation, Image and Video Analysis. RG Score: 7.65, ( <a href="https://www.researchgate.net/profile/Aritra_Dutta3">https://www.researchgate.net/profile/Aritra_Dutta3</a> ), Google Scholar: <a href="https://scholar.google.com/citations?user=vquoiHsAAAAJ&amp;hl=en">https://scholar.google.com/citations?user=vquoiHsAAAAJ&amp;hl=en</a> .	
PUBLISHED ARTICLES	<i>On the Discrepancy between the Theoretical Analysis and Practical Implementations of Compressed Communication for Distributed Deep Learning</i> , ARITRA DUTTA, EL HOUCINE BERGOU, AHMED M. ABDELMONIEM, CHEN-YU HO, ATAL NARAYAN SAHU, MARCO CANINI, AND PANOS KALNIS, in Thirty-Fourth AAAI Conference on Artificial Intelligence (AAAI-20), February 2020.	
	<i>A Nonconvex Projection Method for Robust PCA</i> , ARITRA DUTTA, FILIP HANZELY, AND PETER RICHTÁRIK, in Thirty-Third AAAI Conference on Artificial Intelligence (AAAI-19), 33 (01), pp. 1468-1476, January 2019. <b>(Designated for oral presentation)</b>	
	<i>Online and Batch Supervised Background Estimation via L1 Regression</i> , ARITRA DUTTA AND PETER RICHTÁRIK, WACV 2019–IEEE Winter Conference on the Applications of Computer Vision, pp. 541–550, 2019.	
	<i>A Fast Weighted SVT Algorithm</i> , ARITRA DUTTA AND XIN LI, 2018 5th International Conference on Systems and Informatics (ICSAI), pp.1022–1026, IEEE Xplore, 2018.	

*Weighted Low Rank Approximation for Background Estimation Problems*, ARITRA DUTTA AND XIN LI, In proceedings of IEEE International Conference on Computer Vision Workshops (ICCVW), pp. 1853–1861, IEEE Xplore, 2017.

*A Batch-Incremental Video Background Estimation Model using Weighted Low-Rank Approximation of Matrices*, ARITRA DUTTA, XIN LI, AND PETER RICHTÁRIK, In proceedings of IEEE International Conference on Computer Vision Workshops (ICCVW), pp. 1835–1843, IEEE Xplore, 2017.

*Fast Detection of Compressively-Sensed IR Targets Using Stochastically Trained Least Squares and Compressed Quadratic Correlation Filter*, BRIAN MILLIKAN, ARITRA DUTTA, QIYU SUN, AND HASSAN FOROOSH, IEEE Transactions on Aerospace and Electronic Systems, Vol. 53, Issue 5, pp. 2449–2461, 2017.

*Shrinkage Function and Its Applications in Matrix Approximations*, TOBY BOAS, ARITRA DUTTA, XIN LI, KATIE MERCIER, AND ERIC NIDERMAN, Electronic Journal of Linear Algebra, Vol. 32, pp. 163–171, 2017.

*On a Problem of Weighted Low Rank Approximation of Matrices*, ARITRA DUTTA AND XIN LI, SIAM Journal on Matrix Analysis and Applications, Vol. 38, No. 2, pp. 530–553, 2017.

*A Fast Algorithm for a Special Weighted Low Rank Approximation*, ARITRA DUTTA AND XIN LI, 15th IAPR International Conference on Machine Vision Applications (MVA), IEEE Xplore, pp. 93-96, 2017.

*Initialized Iterative Reweighted Least Squares for Automatic Target Recognition*, BRIAN MILLIKAN, ARITRA DUTTA, NAZANIN RAHNAVAR, QIYU SUN, AND HASSAN FOROOSH, In proceedings of IEEE Military Communications Conference 2015, pp. 506-510, 2015.

SUBMITTED  
ARTICLES

*On the Convergence Analysis of Asynchronous SGD for Solving Consistent Linear Systems*, ATAL NARAYAN SAHU, ARITRA DUTTA, AASHUTOSH TIWARI, AND PETER RICHTÁRIK, November 2019.

*Nuclear Norm Regularized General Weighted Low-Rank Approximation of Matrices*, ARITRA DUTTA, JINGWEI LIANG, AND XIN LI, October 2019.

*Best Pair Formulation & Accelerated Scheme for Non-convex Principal Component Pursuit*, ARITRA DUTTA, FILIP HANZELY, JINGWEI LIANG, AND PETER RICHTÁRIK, May 2019.

*Direct Non-linear Acceleration*, ARITRA DUTTA, EL HOUCINE BERGOU, YUNMING XIAO, MARCO CANINI, AND PETER RICHTÁRIK, January 2019.

*On A Weighted Singular Value Thresholding Algorithm*, ARITRA DUTTA, BOQING GONG, XIN LI, AND MUBARAK SHAH, January 2019.

*Weighted Low-Rank Approximation for Background Modeling*, ARITRA DUTTA, XIN LI, AND PETER RICHTÁRIK, submitted, April 2018.

PH.D. THESIS

*Weighted Low-Rank Approximation of Matrices: Some Analytical and Numerical Aspects*, ARITRA DUTTA, Ph.D. Dissertation, Department of Mathematics, University of Central Florida. Available at: <http://stars.library.ucf.edu/cgi/viewcontent.cgi?article=6631&context=etd>.

WORK IN PROGRESS

*Compressed Communication for Distributed Deep Learning: Survey and Quantitative Evaluation*, HANG XU, CHEN-YU HO, AHMED M. ABDELMONIEM, ARITRA DUTTA, EL HOUCINE BERGOU,

KONSTANTINOS KARATSENIDIS, MARCO CANINI, AND PANOS KALNIS. (95% finished)

*Adaptive Sparsification for Distributed Deep Learning*, ARITRA DUTTA, ATAL N SAHU, AHMED M. ABDELMONIEM, MARCO CANINI, AND PANOS KALNIS.

*Huffman Encoding for Distributed Deep Learning*, RISHIKESH R. GAJJALA, SHASHWAT BANCHHOR, AHMED M. ABDELMONIEM, MARCO CANINI, PANOS KALNIS, AND ARITRA DUTTA. (50% finished)

*Rotation Averaging*, EL HOUCINE BERGOU, ARITRA DUTTA, BERNARD GHANEM, SIVIO GIANCOLA, AND PETER RICHTÁRIK. (60% finished)

TECHNICAL  
REPORTS

*Image Compression Using Simulated Annealing*, ARITRA DUTTA, GEONWOO KIM, MEIQIN LI, CARLOS ORTIZ MARRERO, MOHIT SINHA, COLE STIEGLERK, Mathematical Modeling in Industry XIX, Institute of Mathematics and its Applications, August 2015.

*Efficient and robust solution strategies for saddle-point systems*, JEREMY CHIU, LOLA DAVIDSON, ARITRA DUTTA, JIA GOU, KAK CHOON LOY, MARK THOM, DIMITAR TRENEV, Mathematical Modeling in Industry XVIII, Institute of Mathematics and its Applications Preprint Series 2440, October 2014.

ACADEMIC AND  
INDUSTRIAL  
COLLABORATORS

Center for Research in Computer Vision (CRCV), UCF; Computational Imaging Lab (CIL), UCF; The University of Edinburgh, Scotland; Institut national de la recherche agronomique (INRA), France; IBM Research, Dublin; Amazon Research, Berlin; Department of Applied Maths and Theoretical Physics (DAMTP), University of Cambridge, UK; Google, USA.

COLLABORATIVE  
INDUSTRY PROJECTS

Lockheed Martin Corporation Missiles and Fire Control, Orlando, FL 32819, on *Quadratic Correlation Filter*, since January 2015.

“Math Modeling in Industry XVIII” workshop for graduate students, organized by Institute for Mathematics and its Application (IMA), held in University of British Columbia, in August 2014, to work for EXXONMOBIL on project titled *Efficient and Robust Solution Strategies for Saddle-Point Systems*, under the supervision of Dr. Dimitar Trenev.

“Math Modeling in Industry XIX” workshop for graduate students, organized by IMA, held in University of Minnesota, in August 2015, to work for 1QB INFORMATION TECHNOLOGY on project titled *Sparse Recovery Using Quantum Annealing*, under the supervision of Pooya Ronagh and Prof. Michael Lamoureaux.

EXPERIENCES

May 2017- May 2019

Postdoctoral Fellow, Visual Computing Center  
KAUST, Host: Prof. Peter Richtárik.

Spring 2017

Adjunct, Department of Mathematics, University of  
Central Florida (UCF).

Fall 2016

Graduate Research Assistant, Center for Research in  
Computer Vision (CRCV), UCF.

August 2010 - Fall 2016

Graduate Teaching Assistant and Associate, UCF.

January 2011 - December 2011, Summer  
2012

Graduate Research Assistant, GAUSS Project, UCF.

June 2008 - August 2010

Assistant Professor of Mathematics, FIITJEE Limited,  
India.

SELECTED  
CONFERENCE AND  
INVITED TALKS

Invited talk at the minisymposium SIAM CONFERENCE ON OPTIMIZATION-2020 (SIOPT-20), Hong Kong, May-23-29, 2020.

Invited talk at the special session “New Trends in Optimization Methods and Machine Learning-I and II” at the Sixth International Conference on Continuous Optimization 2019 (ICCOPT 2019), Berlin, Germany, August 3-8, 2019.

Invited talk at Joint Mathematics Meeting, American Mathematical Society’s Annual Meeting, Baltimore, USA, January 2019.

Invited talk *A Nonconvex Projection Method for Robust PCA*, at Stochastic Methods and Approximation Theory for Optimization-I and II, INFORMS annual meeting, Phoenix, AZ, USA, November 2018.

Invited talk at Minisymposium Computational methods for large-scale machine learning in imaging, at SIAM Conference on Imaging Science, Bologna, Italy, June 2018.

Invited talk *Online and Batch Supervised Background Estimation via L1 Regression* at KAUST workshop on Optimization and Big Data, February 2018.

Oral presentation *A Batch-Incremental Video Background Estimation Model using Weighted Low-Rank Approximation of Matrices* at ICCV-Robust Subspace Learning workshop, Venice, Italy, October 2017 (joint work with Prof. Xin Li of UCF and Prof. Peter Richtárik of KAUST and University of Edinburgh).

Oral presentation *Weighted Low Rank Approximation for Background Estimation Problems* at ICCV-Robust Subspace Learning workshop, Venice, Italy, October 2017 (joint work with Prof. Xin Li of UCF).

Invited talk at American Mathematical Society’s Sectional Meeting, Orlando, Florida, September 2017 (joint work with Prof. Xin Li of UCF and Prof. Peter Richtárik of KAUST and University of Edinburgh).

Joint work with Prof. Xin Li for poster presentation *A Fast Algorithm for a Special Weighted Low Rank Approximation* at 15th IAPR International Conference on Machine Vision Applications, Nagoya, Japan, May 2017.

Invited talk *A problem of weighted low-rank approximation of matrices and its applications in machine learning* at American Mathematical Society’s annual meeting at Atlanta, Georgia, January 2017.

Joint work with Prof. Xin Li for his invited talk *On the asymptotic behavior of the solutions to the general weighted low-rank approximation as one block of the weights approach to infinity*, at American Mathematical Society’s annual meeting at Atlanta, Georgia, January 2017.

Selected for poster presentation, The Statistical and Applied Mathematical Sciences Institute (SAMSI), Conference on Distributed and Parallel Data Analysis, September 2016.

Selected for poster presentation, The Statistical and Applied Mathematical Sciences Institute (SAMSI) Optimization Summer School, August 2016.

Final presentation on *Sparse recovery using quantum annealing*, in *Math Modeling in Industry workshop for graduate students XIX* organized by Institute for Mathematics and its Application (IMA), Minnesota, August 2015. Technical report and presentation available at <https://www.ima.umn.edu/2014-2015/MM8.5-14.15/24035>.

Poster presentation, Graduate Research Forum, at UCF, March 2015.

Invited talk *An extension of a result of Golub, Hoffman and Stewart* at American Mathematical Society's annual meeting at San Antonio, Texas, January 2015.

Joint work with Prof. Xin Li for his invited talk *Weighted low-rank matrix approximation: a new algorithm based on optimization* at American Mathematical Society's annual meeting at San Antonio, Texas, January 2015.

Final presentation on *Efficient and robust solution strategies for saddle-point systems*, in *Math Modeling in Industry workshop for graduate students XVIII* at University of British Columbia, Vancouver, organized by Institute for Mathematics and its Application (IMA), August 2014. Technical report available at <https://www.ima.umn.edu/sites/default/files/2440.pdf>. <http://www.mathtube.org/lecture/video/math-modeling-industry-team-4-final-report>.

Talk on *Progress on low-rank matrix approximation* in International Conference on Mathematics and Computing (ICMC 2013), jointly organized by Defense Research and Development Organization of India (DRDO), Indian Institute of Technology KGP, and HIT, December 2013.

Talk on *A numerical method for weighted low-rank matrix approximation* in 79th annual conference of Indian Mathematically Society (IMS), December 2013.

Colloquium talk *Weighted low-rank matrix approximation*, Invited speaker at Tennessee Technological University, October 2013.

#### SPECIAL SESSIONS ORGANIZATION

Minisymposium titled "Stochastic Algorithms for Distributed Optimization" at the SIAM CONFERENCE ON OPTIMIZATION-2020 (SIOPT-20), Hong Kong, May-23-29, 2020, jointly with Dr El Houcine Bergou of INRA and KAUST.

Special session titled "New Trends in Optimization Methods and Machine Learning-I and II" at the Sixth International Conference on Continuous Optimization 2019, Berlin, Germany, August 3-8, 2019, jointly with Dr El Houcine Bergou of INRA and KAUST.

Special session titled "Optimal Methods in Applicable Analysis: Variational Inequalities, Low Rank Matrix Approximations, Systems Engineering, Cyber Security" (SS 81) at the American Mathematical Society's Joint Mathematics Meeting, Baltimore, USA, January 16-19, 2019, jointly with Prof. Ram N. Mohapatra, UCF.

Special session titled "Stochastic Methods and Approximation Theory for Optimization-I and II" at the INFORMS Annual Meeting 2018, Phoenix, Arizona, November 4-7, 2018, jointly with Dr El Houcine Bergou of INRA and KAUST.

#### SELECTED HONORS, FELLOWSHIPS, AWARDS

*Professor Lee H. Armstrong Award for Distinguished Teachers*, Department of Mathematics, UCF, 2017.

*Outstanding Dissertation Award*, Department of Mathematics, UCF, 2016.

Selected as one of 15 student recipients of UCF's Graduate *Dean's Dissertation Completion Fellowship*, Spring 2016.

*Graduate Research Assistantship, Fall 2016*, Center for Research in Computer Vision (CRCV), University of Central Florida (UCF).

Graduate Teaching Assistantship, University of Central Florida.

*Graduate Research Assistantship* 2011 and Summer 2012, for GAUSS PROJECT, a *Computational Science Training for Undergraduates in Mathematical Sciences* funded by NSF.

*Merit scholarship for graduate studies*, Indian Institute of Technology, Dhanbad, 2007-08.

“Ila Mukhopadhyay Memorial Medal-2003” for *Best in Human Qualities*, Presidency College, 2003-04.

TRAVEL  
AWARDS/GRANTS

KAUST comprehensive travel grant to attend SIOPT 2020, Hong Kong, May 2020; AAAI 2020, New York City, USA, February 2020; ICCOPT 2019, Berlin, August 2019; ICML 2019, Long Beach, CA, June 2019; AAAI 2019, Honolulu, Hawaii, January 2019; WACV 2019, Honolulu, Hawaii, January 2019; INFORMS Annual Meeting, Phoenix, Arizona, November 2018; SIAM Conference on Imaging Science, Bologna, Italy, June 2018; Applied Machine Learning Days workshop and conference, EPFL, Lausanne, Switzerland, January 2018; ICCV, Venice, Italy, October 2017; American Mathematical Society’s Sectional Meeting, Orlando, Florida, September 2017.

IMA Travel Award (international airfare and ground transportation, lodging, food) for Integrating Machine Learning and Predictive Simulation: From Uncertainty Quantification to Digital Twins Workshop, March 2018.

SAMSI Optimization Summer School travel and lodging award, August 2016, September 2016.

UCF Mathematics department’s conference registration and travel award, January 2015, November 2015, September 2016, January 2017.

IMA Travel Award (travel, lodging, food) for Math Modeling in Industry Workshop, August 2014 and August 2015.

Student Government Association’s conference registration and travel award, University of Central Florida, August 2014, August 2016.

*Graduate Travel Fellowship*, University of Central Florida, December 2013.

SCIENTIFIC  
REVIEWER

*PC member* of Thirty-Fourth AAAI Conference on Artificial Intelligence (AAAI-20).

*Reviewer* of IEEE International Conference on Computer Vision and Pattern Recognition (CVPR 2020), IEEE International Conference on Computer Vision (ICCV 2017), Neural Information Processing Systems (NeurIPS 2019), IEEE 5th International Conference on Systems and Informatics (ICSAI 2018), International Conference on Machine Learning (ICML 2019, 2020).

*Reviewer* of International Journal for Light and Electron Optics (2018 Impact Factor: 1.914), IEEE Access (2016-’17 Impact Factor: 4.098), Transactions on Signal Processing (2016-’17 Impact Factor: 4.3), IEEE Journal of Special Topics in Signal Processing (2016-’17 Impact Factor: 5.301), SIAM Journal on Matrix Analysis and Applications (2015/2016 Impact Factor: 1.883), SIAM Journal on Imaging Sciences (2015/2016 Impact Factor: 2.687), Numerical Algorithms, Springer (2015/2016 Impact Factor: 1.367).

TEACHING  
EXPERIENCE

Instructor of record for CALCULUS II, CALCULUS III, MATRIX AND LINEAR ALGEBRA, PROBABILITY, RANDOM PROCESS AND APPLICATIONS. (Class capacity 49-55 students)  
Duties included designing syllabi, writing and grading quizzes and tests, lecturing, and holding office hours. Terms: Spring 2014, Summer 2014, Fall 2014 (two sections), Summer 2015, Summer 2016, Fall 2016, Spring 2017.

Teaching Assistant for large class (over 250 students) of CALCULUS I, ORDINARY DIFFERENTIAL EQUATION, COLLEGE ALGEBRA.

Duties included holding recitations, office hours, grading quizzes, group activities and tests, and holding review sessions. Terms: Fall 2012, Fall 2013, Spring 2015, Fall 2015. Two sections in each term.

Mentor for PRE-CALCULUS, CALCULUS I, II, AND III.

Duties included holding problem solving sessions. Terms: Spring 2013, Summer 2013.

Grader for graduate class ADVANCED MATHEMATICS FOR ENGINEERS (MAP 5435).

Duties included grading quizzes and homework assignments. Term: Summer 2012.

#### MENTORING EXPERIENCE

Undergraduate interns, Rishikesh R. Gajjala and Shashwat Banchhor from Indian Institute of Technology, Delhi, December 2019—Present. This work will result in a preprint: *Huffman Encoding for Distributed Deep Learning*

Undergraduate intern, Yunming Xiao from Beijing University of Posts and Telecommunications, Beijing, China during July 2018-December 2019. This work resulted in a preprint: *Direct Non-linear Acceleration*.

Undergraduate interns, Atal Narayan Sahu and Aashutosh Tiwari from Indian Institute of Technology, Kanpur, in undergraduate research project at VCC, KAUST, May-July 2017. This work resulted in a preprint: *On the Convergence Analysis of Asynchronous SGD for Solving Consistent Linear Systems*.

#### SELECTED COURSEWORK

Analysis 1 and 2, Advanced Linear Algebra and Matrix Theory, Scientific Computing, Advanced Numerical Mathematics, Mathematical Statistics, Ordinary Differential Equations and Applications, Partial Differential Equations, Approximation Techniques, Functional Analysis, Wavelets and Their Applications, Numerical Solutions of PDE, Introduction to Differential Geometry, Computer Vision, Complex Variables, Measure and Topology, Analysis of Low Dimensional Structure in High Dimensional Data, Operator Theory (as Directed Research class), Compressive Sensing (as Directed Research class).

#### COMPUTER PROFICIENCY

MATLAB, Python, Julia, TensorFlow, Keras, L<sup>A</sup>T<sub>E</sub>X.

#### PROFESSIONAL RECOGNITION AND HONORS

American Mathematical Society - Graduate student member.

SIAM - Graduate student member.

Member of Computer Vision Foundation (CVF).

Graduated with Udacity Deep Learning Nanodegree. See certificate at <https://graduation.udacity.com/confirm/2LZ7MWWG>.

#### REFERENCES

Prof. Panagiotis Kalnis  
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King Abdullah University of Science and Technology  
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Professor of Applied Maths  
and Computational Science  
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King Abdullah University of Science and  
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Turing Fellow, The Alan Turing Institute  
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Professor and Fellow of American Mathematical Society  
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