

# Parimal Parag

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CONTACT INFORMATION	<b>Indian Institute of Science</b> ECE main building, Room 2.17 Bangalore, KA 560012, India	+91 (80) 2293-2279 parimal@iisc.ac.in <a href="http://www.ece.iisc.ac.in/~parimal">www.ece.iisc.ac.in/~parimal</a>
RESEARCH INTERESTS	Modeling, analysis, and control of large-scale distributed networked systems	
EDUCATION	<b>Ph.D., Texas A&amp;M University, College Station</b> Department of Electrical and Computer Engineering ◇ Dissertation: <i>"Delay-sensitive communications: code-rates, strategies, and distributed control"</i> ◇ Advisors: Jean-François Chamberland & Srinivas Shakkottai	07/2004-12/2011
	<b>M. Tech., Indian Institute of Technology Madras</b> Electrical Engineering, Communication Systems ◇ Dissertation: <i>"Subcarrier allocation for multi-user OFDMA systems"</i> ◇ Advisors: R. Aravind & Srikrishna Bhashyam	07/1999-07/2004
	<b>B. Tech., Indian Institute of Technology Madras</b> Electrical Engineering	07/1999-07/2004
ACADEMIC EXPERIENCE	<b>Associate Professor, Indian Institute of Science</b> Department of Electrical Communication Engineering	12/2020 - present
	<b>Assistant Professor, Indian Institute of Science</b> Department of Electrical Communication Engineering	12/2014 - 11/2020
	<b>Visiting Student Researcher, Stanford University</b> Management Science & Engineering	09/2010 - 12/2010
	<b>Summer Intern, Los Alamos National Lab</b> Computer, Computational and Statistical Sciences	05/2007 - 08/2007
	<b>Research Assistant, Texas A&amp;M University</b> Department of Electrical and Computer Engineering	01/2005-07/2011
INDUSTRIAL EXPERIENCE	<b>Senior Systems Engineer, ASSIA Inc.</b> Expresse Research and Development Conducted research on anomaly detection in broadband networks	09/2011-11/2014
FUNDED PROJECTS	◇ Vehicle to infrastructure communications over 5G testbed, Department of Telecommunications (DoT), 2018-2021. ◇ Design and analysis of distributed storage networks, Science and engineering research board (SERB), 2017-2020.	

## HONORS & AWARDS

- ◇ Control and management of highly mobile tactical ad hoc networks, Defence research and development organization (DRDO), 2014-2017.
- ◇ Co-author of student best paper award at IEEE International Symposium on Information Theory (ISIT), 2018.
- ◇ Early career research award, Science and engineering research board (SERB), Department of Science and Technology, India, 2017.
- ◇ Graduate fellowship, Texas A&M University, 2004.
- ◇ Silver medal, Electrical Engineering department, IIT Madras, 2003.
- ◇ All India rank 7 in ECE stream in Graduate Aptitude Test in Engineering (GATE), 2002.
- ◇ Final-round participant in Indian National Mathematical Olympiad, 1996.
- ◇ Indian National Talent Search scholarship, 1996.

## PUBLICATIONS

### Book Chapters and Theses

- [B1]** P. Parag. *Delay-sensitive communications: code-Rates, strategies, and distributed control*. PhD thesis, Texas A&M University, College Station, TX, USA, July 2011.

### Peer-Reviewed Journal Papers

*Published/Accepted*

- [J19]** R. Jinan, A. Badita, P. K. Sarvepalli, and P. Parag. Latency optimal storage and scheduling of replicated fragments for memory constrained servers. *IEEE Transactions on Information Theory*, 68(6): 4135–4155, June 2022.
- [J18]** A. K. S. Krishnan, C. K. Singh, S. T. Maguluri, and P. Parag. Optimal pricing in multi server systems. *Performance Evaluation*, 154:102282, Apr 2022.
- [J17]** V. Reddyvari, S. C. Bobbili, P. Parag, and S. Shakkottai. Mode-suppression: A simple, stable and scalable chunk-sharing algorithm for P2P networks. *IEEE/ACM Transactions on Networking*, 29(6):2548–2559, Dec 2021.
- [J16]** A. Badita, P. Parag, and V. Aggarwal. Single-forking of coded subtasks for straggler mitigation. *IEEE/ACM Transactions on Networking*, 29(6):2413–2424, Dec 2021.
- [J15]** S. C. Bobbili, S. Bhambay, and P. Parag. Variable length differential encoding for real-time status updates. *IEEE Communication Letters*, 25(4):1129–1133, Apr 2021.

- [J14] R. Jinan, P. Parag, and H. Tyagi. Tracking an auto-regressive process with limited communication per unit time. *MDPI Entropy*, 23(3):347, Mar 2021.
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- [J13] S. C. Bobbili, P. Parag, and J.-F. Chamberland. Real-time status updates with perfect feedback over erasure channels. *IEEE Transactions on Communications*, 68(9):5363–5374, Sep 2020.
- [J12] R. Bitar, P. Parag, and S. El Rouayheb. Minimizing latency for secure coded computing using secret sharing via staircase codes. *IEEE Transactions on Communications*, 68(8):4609–4619, Aug 2020.
- [J11] P. Mayekar, P. Parag, and H. Tyagi. Optimal lossless source codes for timely updates. *IEEE Transactions on Information Theory*, 66(6):3714–3731, Jun 2020.
- [J10] A. Badita, P. Parag, and V. Aggarwal. Optimal server selection for straggler mitigation. *IEEE/ACM Transactions on Networking*, 28(2):709–721, Apr 2020.
- [J09] S. Poojary, S. Bhambay, and P. Parag. Real-time status updates for Markov source. *IEEE Transactions on Information Theory*, 65(9):5737–5749, Sep 2019.
- [J08] A. Badita, P. Parag, and J.-F. Chamberland. Latency analysis for distributed coded storage systems. *IEEE Transactions on Information Theory*, 65(8):4683–4698, Aug 2019.
- [J07] A. Heidarzadeh, J.-F. Chamberland, R. D. Wesel, and P. Parag. A systematic approach to incremental redundancy with application to erasure channels. *IEEE Transactions on Communications*, 67(4):2620–2631, Apr 2019.
- [J06] S. Bhambay, S. Poojary, and P. Parag. Fixed length differential encoding for real-time status updates. *IEEE Transactions on Communications*, 67(3):2381–2392, Mar 2019.
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- [J05] P. Parag, J.-F. Chamberland, H. D. Pfister, and K. R. Narayanan. Code rate, queueing behavior and the correlated erasure channel. *IEEE Transactions on Information Theory*, 59(1):397–407, Jan 2013.
- [J04] P. Parag, S. Sah, S. Shakkottai, and J.-F. Chamberland. Value-aware resource allocation for service guarantees in networks. *IEEE Journal on Selected Areas in Communications*, 29(5):960–968, May 2011.
- [J03] P. Parag and J.-F. Chamberland. Queueing analysis of a butterfly network for comparing network coding to classical routing. *IEEE Transactions on Information Theory*, 56(4):1890–1908, Apr 2010.
- [J02] L. Liu, P. Parag, and J.-F. Chamberland. Quality of service analysis for user cooperation in wireless communication systems using fluid models. *IEEE Transactions on Information Theory*, 53(10):3833–3842, Oct 2007.

- [J01] L. Liu, P. Parag, J. Tang, W.-Y. Chen, and J.-F. Chamberland. Resource allocation and quality of service evaluation for wireless communication systems using fluid models. *IEEE Transactions on Information Theory*, 53(5):1767–1777, May 2007.

## Peer-Reviewed Conference Papers

### *Published/Accepted*

- [C29] G. Gautam, S. Rathee, P. Patil, and P. Parag. A scalable container-based virtualized data center emulation framework. *International Conference on Communication Systems and Networks (COMSNETS)*, Jan 2022.
- [C28] S. Ramanathan, G. Gautam, V. Srinivasan, and P. Parag. Latency-redundancy tradeoff in distributed read-write systems. *International Conference on Communication Systems and Networks (COMSNETS)*, Jan 2022.
- [C27] R. Jinan, A. Badita, P. Sarvepalli, and P. Parag. Low latency replication coded storage over memory-constrained servers. *IEEE International Symposium on Information Theory (ISIT)*, Jul 2021.
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- [C26] P. Parag, P. Patil, S. Shriram, R. Sundaresan, H. Tyagi, N. K. Vaidhiyan. “Antidote” for CoVID-19 pandemic induced surge in online learning. *ACM SIGCOMM Education Workshop*, Jul 2020.
- [C25] R. Jinan, P. Parag, and H. Tyagi. Tracking an auto-regressive process with limited communication. *IEEE International Symposium on Information Theory (ISIT)*, Los Angeles, CA, USA, Jun 21-26, 2020.
- [C24] A. K. S. Krishnan, C. K. Singh, S. T. Maguluri, and P. Parag. Optimal pricing in finite server systems. *International Symposium on Modeling and Optimization in Mobile, Ad Hoc and Wireless Networks (WiOpt)*, Volos, Greece, Jun 15-19, 2020.
- [C23] S. K. Hanna, R. Bitar, P. Parag, V. Dasari, and S. E. Rouayheb. Adaptive distributed stochastic gradient descent for minimizing delay in the presence of stragglers. *International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, Barcelona, Spain, May 04-08, 2020.
- [C22] A. Badita, P. Parag, and V. Aggarwal. Sequential addition of coded tasks for straggler mitigation. *IEEE International Conference on Computer Communications (INFOCOM)*, Beijing, China, Apr 27-30, 2020.
- [C21] P. Sharma, D. Awasare, B. Jaiswal, S. Mohan, N. Abhinaya, I. S. Darwhekar, S. V. R. Anand, B. Amrutur, A. Gopalan, P. Parag, and H. Tyagi. On the latency in vehicular control using video streaming over Wi-Fi. *National Conference on Communications (NCC)*, IIT Kharagpur, India, Feb 21-23, 2020.

- [C20] S. Acharya, B. Amrutur, Y. Simmhan, A. Gopalan, P. Parag, and H. Tyagi. CORNET: A co-simulation middleware for robot networks. *International Conference on Communication Systems & Networks (COMSNETS)*, Bangalore, India, Jan 07-11, 2020.
- [C19] A. Heidarzadeh, J.-F. Chamberland, P. Parag, and R. D. Wesel. A systematic approach to incremental redundancy over erasure channels. *IEEE International Symposium on Information Theory (ISIT)*, Vail, CO, USA, Jun 17-22, 2018.
- [C18] P. Mayekar, P. Parag, and H. Tyagi. Optimal lossless source codes for timely updates. *IEEE International Symposium on Information Theory (ISIT)*, Vail, CO, USA, Jun 17-22, 2018.
- [C17] V. R. Raja, P. Parag, and S. Shakkottai. Mode-Suppression: A simple and provably stable chunk-sharing algorithm for P2P networks. *IEEE Conference on Computer Communications (INFOCOM)*, Honolulu, HI, USA, April 15-19, 2018.
- [C16] P. Parag and J.-F. Chamberland. Novel latency bounds for distributed coded storage. *Information Theory and Applications Workshop (ITA)*, San Diego, CA, Feb 11-16, 2018.
- [C15] S. Poojary, S. Bhambay, and P. Parag. Real-Time Status Updates for Correlated Source. *IEEE Information Theory Workshop (ITW)*, Kaohsiung, Taiwan, November 6-10, 2017.
- [C14] R. Bitar, P. Parag, and S. El Rouayheb. Minimizing latency for secure distributed computing. *IEEE International Symposium on Information Theory (ISIT)*, Aachen, Germany, June 25-30, 2017.
- [C13] P. Parag, A. Bura, and J.-F. Chamberland. Latency analysis for distributed storage. *IEEE Conference on Computer Communications (INFOCOM)*, Atlanta, GA, May 1-4, 2017.
- [C12] S. Bhambay, S. Poojary, and P. Parag. Differential encoding for real-time status updates. *IEEE Wireless Communications and Networking Conference (WCNC)*, San Francisco, CA, March 19-22, 2017.
- [C11] P. Parag, A. Taghavi, and J.-F. Chamberland. On real-time status updates over symbol erasure channels. *IEEE Wireless Communications and Networking Conference (WCNC)*, San Francisco, CA, March 19-22, 2017.
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- [C10] P. Parag and J.-F. Chamberland. Waiting on distributed content. *IEEE Information Theory and Applications (ITA)*, San Diego, CA, February 10-15, 2013.
- [C09] P. Parag and J.-F. Chamberland. Exploiting an interplay between norms to analyze scalar quantization schemes. *IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, Prague, Czech Republic, May 22-25, 2011.

- [C08] P. Parag, S. Shakkottai, and I. Menache. Request routing in multi-ISP P2P content distribution: local or remote? *2nd International ICST Conference on Game Theory for Networks*, Shanghai, China, April 16-18, 2011.
- [C07] M. Amble, P. Parag, S. Shakkottai, and L. Ying. Content-aware caching and traffic management in content distribution networks. *IEEE Conference on Computer Communications (INFOCOM)*, Shanghai, China, April 10-15, 2011.
- [C06] P. Parag, J.-F. Chamberland, H. D. Pfister, and K. R. Narayanan. On the queueing behavior of random codes over a Gilbert-Elliot erasure channel. *IEEE International Symposium on Information Theory*, 1798 – 1802, Austin, TX, June 13-18, 2010.
- [C05] P. Parag, S. Shakkottai, and J.-F. Chamberland. Value-aware resource allocation for service guarantees in networks. *IEEE International Conference on Computer Communications (INFOCOM)*, 1–9, San Diego, CA, March 15-19, 2010.
- [C04] P. Parag, J.-F. Chamberland, H. D. Pfister, and K. R. Narayanan. Code rate, queueing behavior and the correlated erasure channel. *Invited Paper, IEEE Information Theory Workshop*, 1–5, Cairo, Egypt, January 6-8, 2010.
- [C03] P. Parag and J.-F. Chamberland. Queueing analysis of a butterfly network. In *IEEE International Symposium on Information Theory*, 672–676, Toronto, Canada, July 6-11, 2008.
- [C02] L. Liu, P. Parag, J. Tang, W.-Y. Chen, and J.-F. Chamberland. Resource allocation and quality of service evaluation for wireless communication systems using fluid models. *44th Allerton Conference on Communication, Control, and Computing*, 44:1187–1193, Monticello, IL, September 27-29, 2006.
- [C01] P. Parag, S. Bhashyam, and R. Aravind. A subcarrier allocation algorithm for OFDMA using buffer and channel state information. *IEEE 62nd Vehicular Technology Conference*, 62 (1):622–625, September 2005.

#### INVITED TALKS

- “Low latency replication over memory constrained servers,”  
*Department of informatics, IMT Atlantique Brest*, Jun 2022.  
*Munich Workshop on Coding and Cryptography*, Jun 2022.  
*IE Seminar Series, Purdue University*, Sep 2021.
- “Coded parallel server systems,”  
*Dayanand Sagar College of Engineering*, Mar 2022.  
*Vellore Institute of Technology*, Nov 2021.  
*Centre for Networked Intelligence summer school, IISc Bangalore*, Aug 2021.

- “Markov chains: theory and applications,”  
*DRDO CAIR*, Nov 2021.
- “Modeling and optimization of erasure coded systems,”  
*Tutorial, IEEE Information Theory Workshop*, Oct 2021.
- “Data centre networks,”  
*Centre for Networked Intelligence, IISc Bangalore*, Dec 2020.
- “Tracking auto-regressive process with limited communication,”  
*Bombay Information Theory Seminar*, Jan 2020.
- “Real-time status updates for Markov sources,”  
*Bombay Information Theory Seminar*, Jan 2018.  
*IIT Delhi*, Jan 2017.
- “Job completion times in coded parallel systems,”  
*Alliance University at Bangalore*, Sep 2018.  
*Faculty colloquium at IISc Bangalore*, Jan 2018.  
*MVJ College of Engineering at Bangalore*, Aug 2017.  
*Georgia Institute of Technology at Atlanta*, May 2017.  
*Lectures in Probabilities Seminar XI at ISI Delhi*, Nov 2016.
- “Latency analysis for distributed storage,”  
*JTG summer school at IIT Bombay*, May 2017.  
*Texas A&M University at College Station*, May 2017.  
*University of Illinois at Chicago*, Apr 2017.  
*University of California at Berkeley*, Mar 2017.  
*National Conference on Communication at IIT Madras*, Mar 2017.  
*IBM Research*, Feb 2017.

TEACHING  
EXPERIENCE

**Indian Institute of Science**

*Lecturer*

- ◇ E2 204: Stochastic Processes and Queueing Theory    Spring 2015-2022
- ◇ E2 202: Random Processes    Fall 2017-2022
- ◇ E2 236: Foundations of Machine Learning    Spring 2019-2022
- ◇ E2 334: Topics in Computation over Networks    Spring 2018-2022
- ◇ E1 244: Estimation and Detection Theory    Spring 2016-2017
- ◇ E0 201: Proofs and Measures    Fall 2015

**Texas A&M University**

*Guest Lecturer*

- ◇ ECEN 303 – Random Signals and Systems    Spring 2010
- ◇ ECEN 601 – Linear Network Analysis    Fall 2009
- ◇ ECEN 662 – Estimation and Detection Theory    Spring 2009

- ◇ ECEN 683 – Wireless Communications Fall 2008

### **Texas A&M University**

#### *Teaching Assistant*

- ◇ ECEN 214 – Electric Circuit Theory Spring 2008
- ◇ ECEN 314 – Signals and Systems Fall 2007

### **Indian Institute of Technology Madras**

#### *Teaching Assistant*

- ◇ EE 611 – Digital Coding & Modulation Spring 2004
- ◇ EE 320 – Principles of Communication Fall 2003

### PROFESSIONAL SERVICE

#### **Program Chair**

- ◇ ACM SIGMETRICS: Posters and student activities 2022
- ◇ International Conference on Signal Processing and Communications (SP-COM): Finance 2022, Invited sessions 2020, Publications 2018, Web 2016
- ◇ The ACM International Symposium on Mobile Ad Hoc Networking and Computing (MobiHoc) : Posters and Demonstrations 2018, Workshops 2017
- ◇ International Conference on Communication Systems and Networks (COMSNETS): Intelligent Transportation Systems Workshop 2018
- ◇ IEEE International Conference on Advanced Networks and Telecommunications Systems (ANTS): Technical Program Committee 2016

#### **Technical Program Committee**

- ◇ Chair: SPCOM 2024, ANTS 2016
- ◇ Member: ITW (2022), ICC-WC(2022, 2023), ISIT(2021), WiOpt (2020), SPCOM (2022, 2020, 2018, 2016), MobiHoc (2019, 2018, 2017, 2016), ValueTools (2022), NCC (2022, 2017, 2016, 2015), COMSNETS (2023, 2022, 2017, 2016, 2015), COMSNETS ITS workshop 2016, Globecomm LTE - Advanced and Beyond 4G workshop (2013, 2012)

#### **Organizing Committee**

- ◇ National Conference on Communication (NCC) 2017, 2016, International Conference on Signal Processing and Communications (SPCOM) 2022, 2020, 2018, 2016, JTG Summer School on Information Theory (JTG 2023, JTG 2016, JTG 2015), IISc-DRDO Workshop on Mobile Ad-Hoc Networks (2015)

#### **Reviewer**

- ◇ IEEE Transactions on Information Theory, IEEE/ACM Transactions on Networking, IEEE Transactions on Parallel and Distributed Systems, IEEE Journal On Selected Areas In Communications, IEEE Transactions on Communications, IEEE Transactions on Wireless Communications
- ◇ IEEE Conference on Computer Communications (INFOCOM), International Symposium on Information Theory (ISIT), The ACM International Symposium on Mobile Ad Hoc Networking and Computing (MobiHoc), International Symposium on Modeling and Optimization in Mobile, Ad Hoc and Wireless Networks (WiOpt), National Conference on Communications (NCC)



MEMBERSHIPS IEEE, Information Theory Society, Communications Society, Signal Processing Society, ACM