CURRICULUM VITAE

PERSONAL DETAILS

Name:	Saptarshi Bandyopadhyay
Date of Birth:	23rd October, 1987
Address:	505 E White St, Apt 6, Champaign, Illinois – 61801, United States
Phone:	+1-217-979-8113
Email Address:	saptarshi.bandyopadhyay@gmail.com, bandyop2@uiuc.edu
Webpage:	publish.illinois.edu/saptarshibandyopadhyay/

EDUCATIONAL QUALIFICATIONS

Examination	Institute	Year	CPI/GPA
Doctor of Philosophy (PhD)	Department of Aerospace Engineering, University of Illinois at Urbana-Champaign (UIUC)	2011 onwards	(GPA: 3.81/4.0)
Dual Degree (Bachelor & Master of Technology)	Department of Aerospace Engineering, Indian Institute of Technology Bombay (IIT Bombay)	2010	8.83/10

RESEARCH INTERESTS

Theory	Application
• Control Theory	• Formation Flying
• Probability Theory	• Distributed Estimation
• Synchronization & Consensus	• Small Satellites (CubeSats)
• Network Analysis	• Robotics (Quadrotors)
• Systems Engineering	• Flying Cars

SCHOLASTIC ACHIEVEMENTS

- Finalist in the IEEE Multi-Conference on Systems and Control Best Student Paper Award competition *[2014]*
- Awarded the Aerospace Alumni Advisory Board Fellowship at UIUC *[2014]*
- Received Stillwell Fellowship for pursuing PhD at UIUC *[2011]*
- Awarded Boeing Scholarship by IIT Bombay for 'exceptional overall performance' *[2010]*
- Awarded the Institute Academic Prize for securing 1st rank among Dual Degree students in Aerospace Department, IIT Bombay. *[2008]*
- Won Gold Medal in the National Physics Olympiad *[2005]*
- Won Gold Medal for India in 9th International Astronomy Olympiad held in Ukraine *[2004]*
- Awarded the National Talent Search Examination (NTSE) scholarship from National Council of Education Research and Training, Government of India *[2003]*
- Won Gold Medal in the International Competition for Schools (Mathematics) by the University of New South Wales (UNSW), Australia *[2000]*

PUBLICATIONS

Topic: Formation Flying, Synchronization, Swarm Guidance

Journals

1. S. Bandyopadhyay, S.-J. Chung and F. Y. Hadaegh, "Probabilistic Swarm Guidance using Optimal Transport with Application to Spacecraft Swarms," AIAA Journal of Guidance, Control, and Dynamics (JGCD), to be submitted, 2014.
2. S. Bandyopadhyay, S.-J. Chung and F. Y. Hadaegh, "Probabilistic Swarm Guidance using Inhomogeneous Markov Chains," IEEE Transactions on Control of Network Systems (TCNS), revision under review, 2014. (arxiv)
3. S.-J. Chung, S. Bandyopadhyay, I. Chang, and F. Y. Hadaegh, "Phase Synchronization Control of Complex Networks of Lagrangian Systems on Adaptive Digraphs," Automatica, vol. 49, no. 5, pp. 1148-1161, May 2013. (pdf)

Conferences

4. S. Bandyopadhyay, S.-J. Chung, and F. Y. Hadaegh, "Probabilistic Swarm Guidance using Optimal Transport," IEEE Multi-Conference on Systems and Control (MSC), Antibes, France, Oct. 2014. (Best Student Paper Award Finalist)
5. D. Morgan, G. P. Subramanian, S. Bandyopadhyay, S.-J. Chung and F. Y. Hadaegh, "Probabilistic Guidance of Distributed Systems using Sequential Convex Programming," International Conference on Intelligent Robots and Systems (IROS), Chicago, IL, September, 2014.
6. S. Bandyopadhyay, S.-J. Chung, and F. Y. Hadaegh, "Inhomogeneous Markov Chain Approach to Probabilistic Swarm Guidance Algorithm," 5th Int. Conf. on Spacecraft Formation Flying Missions and Technologies (SFFMT), Munich, Germany, May 2013.
7. S. Bandyopadhyay, C. M. Saaj, and B. Bandyopadhyay, "Stability analysis of small satellite formation flying and reconfiguration missions in deep space", 12th International Workshop on Variable Structure Systems (VSS), Mumbai, India, 12-14 Jan. 2012.
8. S. Bandyopadhyay, C. M. Saaj, and B. Bandyopadhyay, "Development of Sliding Mode Controller for Small Satellite in Planetary Orbital Environment Formation Flying Missions", International Astronautical Congress (IAC), Prague, 2010.
9. C. M. Saaj, S. Bandyopadhyay, and B. Bandyopadhyay, "Robust Control and Path Planning Algorithms for Small Satellites in Formation Flying Mission", International Astronautical Congress (IAC), Daejeon South Korea, 2009.

Topic: Distributed Estimation, Sensor Fusion

Journal

1. S. Bandyopadhyay and S.-J. Chung, "Distributed Estimation using Bayesian Consensus Filtering," IEEE Transactions on Automatic Control (TAC), revision under preparation, 2014. (arxiv)

Conference

2. S. Bandyopadhyay and S.-J. Chung, "Distributed estimation using Bayesian consensus filtering," in IEEE American Control Conference (ACC), Portland, OR, June 2014.

Topic: Systems Engineering, CubeSat

Journal

1. S. Bandyopadhyay, S.-J. Chung and F. Y. Hadaegh, “Attitude Stabilization of a Captured Asteroid for the Asteroid Redirect Mission,” AIAA Journal of Spacecraft and Rockets, to be submitted, 2014.

Conferences

2. S. Bandyopadhyay, G. P. Subramanian, R. Foust, S. Chan, D. Morgan, S.-J. Chung, F. Y. Hadaegh, "On Impending Small Satellite Formation Flying Missions and Technologies," AIAA Small Satellites, Kissimee, FL, January, 2015. accepted.
3. G. P. Subramanian, S. Chan, R. Foust, Y. Taleb, D. Rogers, J. Kokkat, S. Bandyopadhyay, D. Morgan, S.-J. Chung, F. Y. Hadaegh, "Systems Engineering Study of Formation Flying Technology Demonstration Mission," AIAA Small Satellites, Kissimee, FL, January, 2015. accepted.
4. S. Bandyopadhyay, S.-J. Chung and F. Y. Hadaegh, “Attitude Stabilization of a Captured Asteroid for the Asteroid Redirect Mission,” AIAA Guidance, Navigation, and Control (GNC), Kissimee, FL, January, 2015. accepted.
5. E. Dahan, Z. Herman, C. Procaccino, T. Wang, S. Bandyopadhyay, D. Ahern, S. D’Urso, "Investigation into System Functionality and Decomposition as an Extension to Previous Mars Exploration Studies," AIAA SPACE 2013 Conference & Exposition, San Diego, CA, September 2013.
6. S. S. Mulay, J. Joshi, Y. S. Chati, V. V. Unhelkar, S. Bandyopadhyay, S. Tamaskar, M. Bommanahal, C. Talnikar, and A. Kumar, "Attitude Determination and Control of Pratham, Indian Institute of Technology Bombay’s First Student Satellite", 1st IAA Conference on Dynamics and Control of Space Systems, Porto, Portugal, March, 2012.
7. J. Jha, D. Thakur, K. Neema, T. Jadhav, M. Rachh, and S. Bandyopadhyay, “Design of the Groundstation, Polarization Measurement Setup and the Social Goal of Pratham, Indian Institute of Technology Bombay's First Student Satellite”, 1st IAA Conference on University Satellites Missions and Cubesat Workshop, Roma, Italy, January 2011.
8. S. Bandyopadhyay, J. Jha, H. Mukundarajan, A. Damle, D. Thakur, S. Mulay, P. Sachdeva, J. Joshi, V. Unhelkar, Y. Chati, M. Chaturvedi, N. Parab, M. Rachh, S. Tamaskar, M. Bommanahal, A. Goel, K. Neema, S. Das, V. Sresht, R. Pai, A. Chiplunkar, “Introduction to Pratham, IIT Bombay’s Student Satellite Project”, Indian Small Satellite Systems Conference, Bangalore, India, April 2010.
9. S. Bandyopadhyay, J. Jha, A. Goel, D. Thakur, K. Neema, M. Rachh, N. Reddy, S. Meesla, and S. Das, “Measurement of Total Electron Count of the Ionosphere and the Social Goal of Pratham, Indian Institute of Technology Bombay’s first Student Satellite”, International Astronautical Congress, Prague, 2010.
10. S. Bandyopadhyay, H. Mukundarajan, S. Mulay, M. Chaturvedi, M. Patel, S. Diwale, A. Shah, G. P. Subramanian, A. Subramanyam, K. Kaur, M. Dhanasree, A. Kumar, and K. R. Eedara, “System Engineering and Integration of Pratham, Indian Institute of Technology Bombay’s first Student Satellite”, International Astronautical Congress, Paper ID: IAC-10.B4.1.8, Prague, 2010 organized by International Astronautical Federation.

PHD THESIS RESEARCH, UIUC *[Aug 2011 to present]*

Advisor: Prof. Soon-Jo Chung (UIUC)

Distributed Estimation using Bayesian Consensus Filtering (BCF)

- BCF can track a moving target using a networked group of agents and achieve consensus on the best estimate of the pdf of the target's states, in information theoretic sense.
- The BCF framework can incorporate general nonlinear target dynamic models, heterogeneous nonlinear measurement models, and higher–order moments of the locally estimated pdf of the target's states obtained using Bayesian filters.

Probabilistic Swarm Guidance using inhomogeneous Markov chains (PSG-IMC) and Optimal Transport (PSG-OT)

- PSG-IMC involves designing an inhomogeneous Markov chain so that each autonomous agent or robot determines its own trajectory in a statistically independent manner, so that the swarm converges to the desired formation and the agents repair the formation even if it is externally damaged, and minimize the number of transitions required for achieving the desired formation and then maintaining it.
- PSG-OT is an optimal distributed probabilistic swarm guidance algorithm using optimal mass transport, where the Monge-Kantorovich minimization problem is solved using Linear Programming. We have also developed a distributed collision avoidance algorithm by modifying Voronoi partitions within each bin.

Summer Internship at Jet Propulsion Laboratory (JPL), California Institute of Technology (Caltech) *[June – August, 2013]* *[June – August, 2014]*

- Developed probabilistic swarm guidance algorithms using inhomogeneous Markov chains in collaboration with Dr. Fred Hadaegh.
- Theoretical research on asteroid capture and stabilization using adaptive control.

CubeSat Design Study in collaboration with JPL, Caltech

- Generated a detailed literature survey, requirement definition and preliminary design report on the development and operation of 4-6 networked, formation flying, CubeSats with 6-DOF precision maneuvering capability.

PRATHAM, IIT BOMBAY STUDENT SATELLITE PROJECT *[Aug 2007 to July 2011]*

Project Manger www.aero.iitb.ac.in/pratham

- Founded the 1st Student Satellite Project of IIT Bombay, worth INR 1.5 Crore ($300,000), with support from Indian Space Research Organization (ISRO).
  - The Mission of the Satellite, named Pratham, is to measure Total Electron Count (TEC) of the Ionosphere above India, with 0.1TECU accuracy.
  - Pratham is a 260mm cube weighing approx. 10kgs with a mission life of 4 months.
- Lead a team of 30 students for the design of Pratham. The team was mentored by about 20 faculty members from various departments.
- Responsible for the System Integration and Quality Assurance of the Mission.
- Along with the *Quality Sub-System*, designed and built a Clean Room.

System Engineer

- Captured System and Sub-System Requirements and generated Critical Parameters for all the 10 Sub-Systems of Pratham.
- Conceptualized the Integration Sequence of the Satellite and working with the *Integration Sub-System* towards the Design and Fabrication of the Satellite's structure.
- Developing the Hardware in Loop Simulator (HILS) along with the *On Board Computer Sub-System*, for testing the electrical Sub-Systems of the integrated Satellite.

Outreach Programme

- Conducted 2 national level workshops along with the *Communication and Ground Station Sub-System*, to help students from 11 universities to build low cost (INR 25000, $500) Ground Stations for Pratham in their own universities.
- Worked with the *Thermals Sub-System* in establishing a Virtual Laboratory, by web-enabling their simulations, that is accessible to students all over the country. This endeavor is supported by the Center for Distance Engineering Education Programme, IITB and the Ministry of Human Resource and Development (MHRD).

ACADEMIC PROJECTS

Caltech Space Challenge at Caltech, US *[September 2011]*

- Member of Team Explorer, which was awarded 2nd place in designing a 180 day manned mission to the Near Earth Asteroid 1999AO10 to be launched in 2026.
- The workshop was supported by Caltech, JPL, NASA, ESA and JAXA and sponsored by Lockheed Martin, SpaceX, Orbital Sciences and AGI.

Masters Thesis at IIT Bombay *[Jan 2009 to Sept 2011]*

Advisors: Prof. B. Bandyopadhyay (IIT Bombay), Dr. C. Saaj (Surrey Space Centre)

Topic: Position and Attitude Control of Satellites in Formation Flying Mission using Sliding Mode Control (SMC)

- Project funded by the Royal Society, UK and in collaboration with Surrey Space Center, UK.
- Implemented the Artificial Potential Field concept for navigation and Sliding Mode Control for controlling the motion of Satellites in a Formation Flying Mission.

Other Projects

- MIT Media Lab's Design and Innovation Workshop 2011 at College of Engineering Pune. *[January 2011]*
- Junior Year Thesis (Seminar) on Passive Stabilization of Satellites using Gravity-Gradient Booms. *[Spring 2008]*
- Summer internship at Space Astronomy and Instrumentation Division (SAID), ISRO Satellite Center (ISAC), Bangalore. *[May – June 2007]*
- Nurture Camp at Aryabhatta Research Institute of Observational Sciences (ARIES), Department of Science and Technology (DST), Manora Peak, Nainital. *[Dec 2006]*
- Visiting Student Research Programme (VSRP) at National Center for Radio Astronomy (NCRA), Tata Institute of Fundamental Research (TIFR), Pune *[June – July 2006]*
- Nurture Camp at Vainu Bappu Observatory (VBO), Indian Institute of Astrophysics (IIA), Kavalur. *[Dec 2005]*

TEACHING EXPERIENCE

- Teaching Assistant for the AE 443 Senior Design Project, UIUC. 2 teams won the top positions in the AIAA Undergraduate Team Space Design Competition. *[Spring 2012]*
- Teaching Assistant for the AE207 Introduction to Engineering Design course and AE152 Introduction to Aerospace Engineering course at IIT Bombay. *[2009-2010]*
- Student Facilitator for the 8th National Astronomy Olympiad. Successfully trained the Indian Team of 5 students to win 4 gold medals and 1 bronze medal in the 11th International Astronomy Olympiad held in Mumbai, India. *[May 2006 – Nov 2006]*
- Mentor for Robotics and Technical activities at IIT Bombay. Awarded Institute Technical Special Mention (2006), Hostel Technical Colour (2006), Hostel Organizational Colour (2007), Institute Passing-out Technical Citation (2010) and Hostel Passing-Out Technical Colour (2010) for my work. *[Mar 2006 – May 2010]*
- Appointed Institute Student Mentor to guide the freshmen batch. Appointed Department Academic Programme Mentor to guide academically weak students in the third year batch. *[July 2009 – Apr 2010]*

REFERENCES

Prof Soon-Jo Chung	Assistant Professor, Department of Aerospace Engineering, UIUC [Phone: +1-217-2442737, sjchung@illinois.edu]
Dr. Fred Y. Hadaegh	Associate Chief Technologist, Jet Propulsion Laboratory (JPL), California Institute of Technology, Pasadena [Phone: +1-818-3548777, Fred.Y.Hadaegh@jpl.nasa.gov]
Prof P. M. Mujumdar	Professor, Department of Aerospace Engineering, IIT Bombay Dean Research and Development, IIT Bombay Former Head of Department, Head of Centre for Aerospace Systems Design and Engineering (CASDE) [Phone: +91-22-27567116, mujumdar@aero.iitb.ac.in]
Prof. B. Bandyopadhyay	Professor, Interdisciplinary Programme in Systems and Control Engineering, IIT Bombay Former Head of Department [Phone: +91-22-27567889, bijnan@ee.iitb.ac.in]
Prof K. Sudhakar	Professor (retired), Department of Aerospace Engineering, IIT Bombay Former Head of Department, Co-PI of Centre for Aerospace Systems Design and Engineering (CASDE) [Phone: +91-22-27567111, sudhakar@aero.iitb.ac.in]
Prof. H. Arya	Associate Professor, Department of Aerospace Engineering, IIT Bombay [Phone: +91-22-27567118, arya@aero.iitb.ac.in]
Dr. C. Saaj	Surrey Space Centre, Faculty of Engineering & Physical Sciences University of Surrey, United Kingdom [Phone: +44-1483-682225, c.saaj@surrey.ac.uk]