

# Sandra Hala Dandach

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## Education

- Ph.D.** University of California, Santa Barbara, CA, USA, Mechanical Engineering. Sep'07- Jun'11  
Center for Control, Dynamical Systems and Computation.  
Advisor: Francesco Bullo  
Thesis: Distributed Decision Making.
- M.Sc.** University of California, Santa Barbara, CA, USA, Mechanical Engineering. Sep'05 -Sep'07  
Center for Control, Dynamical Systems and Computation.  
Advisor: Mustafa Khammash  
Thesis: Bacterial Competence: Stochastic Strategies for Survival.
- M.Sc.** University of Iowa, Iowa city, IA, USA, Electrical Engineering. Sep'03-Aug'05  
Advisor: Soura Dasgupta  
Thesis: Stability of Adaptive Delta Modulation With and Without a Forgetting Factor.
- B.E.** American University of Beirut, Beirut, Lebanon, Electrical Engineering. Sep'98-Jul'02  
Area of emphasis: Automation, robotics and control.

## Research Interests

1. Optimal space allocation, distributed algorithms design, control theory, optimization theory.
2. Statistical learning, reinforcement learning, data visualization, decision theory, detection & estimation theory.
3. Mathematical modeling of interaction between individuals, opinion dynamics, clustering on large networks.
4. Systems biology, computational methods.
5. Control over communication channels, signal processing in control.

## Work Experience

**Senior Research Scientist**, United Technologies Research Center, West Hartford, CT. Jul'11- present

1. Smart residential devices (Jan'12-present)  
Using statistical learning and reinforcement learning algorithms to improve energy consumption in residential devices.
2. Autonomous air vehicle (Sept'11-Dec'11)  
Designed and implemented an improved Simultaneous Localization and Mapping (SLAM) method that uses prior knowledge about the environment while remaining robust to errors in the prior. We showed that an AUV implementing the proposed algorithm was able to recover from errors of up to 50% in the prior, we also showed that the overall confidence in our proposed algorithm is driven by the confidence level in the prior.
3. Clustering on large networks (Aug'11-Dec'11)  
Designed a state of the art clustering algorithm by allowing cooperative estimation between nodes of the network to be clustered. The proposed algorithm gave an accuracy that increased up to a factor of 3 with a decreased time for clustering of up to a factor of 20 when compared to state of the art clustering algorithms.

**Graduate Research Associate**, University of California, Santa Barbara. Sep'07-Jul'11.

Investigated two different aspects of decision theory on a network:

1. Cooperative detection. Major contributions:

- Designed distributed algorithms to solve regional localization as a multi-hypothesis problem.
- Provided convergence results and performance measures of the suggested algorithms.
- Improved the performance of the algorithms by optimally partitioning the environment.

2. Cooperative decision making. Major contributions:

- Provided a novel computational method that allowed exact analysis of the accuracy and time of a network of cooperative agents.
- Conducted sensitivity analysis for two special rules, and showed that the performance and decision time for large networks are defined by the performance at special times for a single individual.
- Showed that the optimal fusion rule varies with the local fusion rules and the network size as well as the desired performance.

**Graduate Research Associate**, University of California, Santa Barbara.

Sep'05-Aug'07.

Studied the problem of stochastic switching in Bacillus-subtilis bacteria. Major contributions:

1. Provided a novel computational method that gave analytical answers to the Chemical Master Equation often used in the analysis of genetic circuits.
2. Investigated the expected time and the sensitivity of the stochastic switching in cells to various binding affinities, transcription rates, degradation rates, etc.

**Graduate Research Associate**, University of Iowa, Iowa City.

Sep'03-Aug'05.

Investigated the following two problems:

1. Stability of adaptive delta modulation (ADM). Major contributions:
  - Proved that the classical ADM algorithm enters in periodic cycles.
  - Modified the ADM algorithm to limit the magnitude of the oscillations.
2. Source localization with mobile agents. Major contributions:
  - Designed a continuous-time algorithm that localizes a source without amplification of noise.
  - Showed that the algorithm converges exponentially fast under mild conditions on the agent motion and continues to successfully localize a slowly moving source.

**Teaching Assistant**, University of California, Santa Barbara.

Sep'05-present.

Courses: Control Systems Design I, Control System Design II, Engineering Mechanics: Dynamics.

Duties included teaching weekly discussion sections, teaching several classes, preparing laboratory experiments, leading laboratory sessions, grading assignments as well as midterms and finals, assigning tasks to other teaching assistants, ensuring coordination between the various teaching assistants.

**Teaching Assistant**, American University of Beirut, Lebanon.

Sep'02-Sep'03

Course: Instrumentation, sensors and actuators.

Duties included help leading weekly laboratory sessions, grading assignments.

## Technical Skills

- **Languages:** Fluently speak, read and write: English, French and Arabic.
- **Computer skills:** Mathematica, Matlab, Labview, PLC programming, basic knowledge of C and C++.
- **Laboratory skills:** basic knowledge on how to perform biochemical experiments (CheY) cloning, protein purification, PCR, agarose gel electrophoresis and protein data analysis.
- **Personal skills:** Very active, very fast learner, great team player, great presentation skills.

## Professional Service

**Workshops and conferences** Co-Organized the 2011 *Decision, Dynamics and Control in Multi-Agent Systems* in Santa Barbara, is organizing a tutorial session on climate control and security for the American Control Conference (to take place in 2012).

### Technical Reviewer

Automatica, Journal of Guidance, Control and Dynamics, IEEE Conference on Decision and Control, IFAC World Congress, American Control Conference, European Control Conference, IFAC Symposium on System Identification.

### Professional Affiliations

Biophysical Society, Institute of Electrical and Electronics Engineers (IEEE), IEEE Control Systems Society (IEEE CSS), IEEE Computer Society, IEEE Women in Engineering, IEEE Aerospace and Electronic Systems Society, IEEE Robotics and Automation Society.

## Publications

### Journal Articles

1. S.H. Dandach, R. Carli and F. Bullo, **Accuracy and Decision Time for Sequential Decision Aggregation**, *Proceedings of the IEEE*, invited paper to the special issue on *Interaction Dynamics: the Interface of Humans and Smart Machines*, 100(3), 2012.
2. S.H. Dandach and F. Bullo, **Distributed Sequential Algorithms for Regional Source Localization**, *Automatica*. (Provisionally accepted. Available at [http://motion.mee.ucsb.edu/~sandra/Seq\\_loc.pdf](http://motion.mee.ucsb.edu/~sandra/Seq_loc.pdf))
3. S.H. Dandach and M. Khammash, **Analysis of stochastic strategies in bacterial competence: a master equation approach**, *PLoS Computational Biology*, 6(11), 2011.
4. S.H. Dandach, S. Dasgupta and B.D.O. Anderson, **Stability of Adaptive Delta Modulators with Forgetting Factor and Constant Inputs**, *International Journal of Adaptive Control and Signal Processing*, 25(8), 2011.
5. S.H. Dandach, B. Fidan, S. Dasgupta and B.D.O. Anderson, **A Continuous Time Linear Adaptive Source Localization Algorithm, Robust to Persistent drift**, *Systems and Control Letters*, 58(1), 2009.

### Conference Publications

1. S.H. Dandach and Mustafa Khammash, **A Novel Computational Method for Stochastic Strategies for Bacterial Survival Analysis**. Invited session on "Dynamics and Control of Cellular Systems", in *American Control Conference*, 2011, San Francisco, CA.
2. S.H. Dandach, R. Carli and F. Bullo, **Accuracy and Decision Time for a Class of Sequential Decision Aggregation Rules**. *Conference for Decision and Control*, 2010, Atlanta, GA.
3. S.H. Dandach, R. Carli and F. Bullo, **Accuracy and decision time for cooperative implementations of the sequential probability ratio test**. Invited session on "humans-in-loop systems", in *American Control Conference*, Baltimore, MD, June 2010.
4. S.H. Dandach and F. Bullo, **Algorithms for regional source localization**, in *American Control Conference*, St. Louis, MO, pages 5440-5445, June 2009.
5. S.H. Dandach, B. Fidan, S. Dasgupta and B.D.O. Anderson, **Adaptive source localizations by mobile agents**, in *IEEE Conference on Decision and Control*, pages 2045-2050, San Diego, CA, December 2006.
6. S.H. Dandach, S. Dasgupta and B.D.O. Anderson, **Stability of adaptive delta modulators with a forgetting factor and constant inputs**, in *IEEE Conference on Decision and Control and the European Control Conference*, pages 5808-5813, Seville, Spain, December 2005.

7. S.H. Dandach, S. Dasgupta and B.D.O. Anderson, **Stability of adaptive delta modulators with constant inputs**, in *IASTED International Conference of Networks and Communication Systems*, Krabi, April 2005.
8. S.H. Dandach, S. Dasgupta and J. Freudenberg, **Control over bandlimited communication in channels: Intersampling performance**, in *Proceedings of the International Conference on Systems, Man and Cybernetics*, pages 3886-3601. The Hague, October 2004.
9. S.H. Dandach, S. Dasgupta, **Optimal design of stable haptic interfaces**, in *Proceedings of SICE 2004 Annual Conference*, Sapporo, Japan, August 2004.
10. F.Mrad, S.H. Dandach, S. Azar and G. Deeb, **Operator-friendly common sense controller with experimental verification using LabVIEW**, in *Proceedings of the 2005 International Symposium on Intelligent Control*, Cyprus, June 2005.

## References

1. **Francesco Bullo** University of California, Santa Barbara. Department of Mechanical Engineering. Center for Control, Dynamical Systems and Computation.  
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2. **Bassam Bamieh** University of California, Santa Barbara. Department of Mechanical Engineering. Center for Control, Dynamical Systems and Computation.  
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3. **Soura Dasgupta** University of Iowa, Iowa City. Department of Electrical and Computer Engineering.  
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