

Sandra Hala Dandach

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Summary

Researcher with many years of experience and a wide range of analytical skills including system and control theory, dynamical systems modeling, machine learning, statistical analysis, mathematical modeling and data analytics.

Education

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| Ph.D. Mechanical Engineering, University of California, Santa Barbara, CA, USA.
Center for Control, Dynamical Systems and Computation.
Thesis: Distributed decision making: Analysis and applications.
Advisor: Francesco Bullo | Sep'07- Jun'11 |
| M.Sc. Mechanical Engineering, University of California, Santa Barbara, CA, USA.
Center for Control, Dynamical Systems and Computation.
Thesis: Bacterial competence: stochastic strategies for survival.
Advisor: Mustafa Khammash | Sep'05 -Sep'07 |
| M.Sc. Electrical Engineering, University of Iowa, Iowa city, IA, USA.
Thesis: Stability of adaptive delta modulation with and without a forgetting factor.
Advisor: Soura Dasgupta | Sep'03-Aug'05 |
| B.E. Electrical Engineering, American University of Beirut, Beirut, Lebanon. | Sep'98-Jul'02 |

Work and Research Experience

Senior Data Scientist, MetaScale, San Jose, CA **Jul'13-present**

Improve member experience by creating a member centric strategy to personalize services as well as online and in store offers.

- **Personal shopper to client matching:** Matched members to online personal shoppers to increase member interaction with the "shopyourway.com" platform. Used online and in store data to conduct product-level interest and expertise analysis based on which individuals and shoppers were matched. Similarity between individuals was used to break ties when needed. Although the interaction between the members and the personal shoppers happens mostly online, purchases can take place both online and in store.
- **Personalized offer design:** Clustered members into groups with various offer perception then used logistic regression to learn functions that model the probability of redemption for each group as offers vary. The analysis allows personalizing offers while keeping the discount value constant. Data here is constituted of demographical information, transactional data as well as membership information.
- **Targetted offer matching:** Used random forest on mixed data to associate customer information and purchase history, to departments of interest; this analysis allowed improving targetted coupon dispensing. Data here is constituted of demographical information and transactional data.
- **Self learning feature selection:** Used feature selection techniques to rank a preselected number of the most informative features for offer to customer matching. The features were used to train the IBM self learning engine; market testing for performance improvement is in preparation. Data here was the whole space of data available about shop your way members.
- **Employee mood ring:** Served as a consultant for the Human Resources analytics team on a project studying the effect of employees mood on sales. Recommended changes on the target as well as the learning algorithm, that lead to a greater predictive power of the models. Recommended applications that introduced actionable items where the business value of the study became clearer.

Senior Research Scientist, United Technologies Research Center, CT Jul'11- Jun'13

Control Group, Systems Department Helped explore and introduce research opportunities for future technologies in United Technologies (Sikorsky helicopters, Pratt and Whitney and Hamilton Sundstrand now merged into UTC aerospace, Carrier HVAC systems, OTIS elevators, Fire and Security and UTC power).

- **Compressor map:** Worked with the modeling team in **Pratt and Whitney** to model and simulate the Auxiliary Power Unit (APU) bleed and actuator control systems. Built and implemented a physics based model as part of the analysis of the unit. Then designed system identification experiments to model the system and simulated the compressor efficiency and mass flow rate by parametrically modeling the corresponding maps. The learned model is used in evaluating closed loop control strategies and in predicting the mass flow and efficiency of the APU when experimental data is unavailable. I was awarded a great job recognition for this work by the research center.
- **Smart human machine interface:** This initiative aimed to explore research directions to make the first smart thermostat by **Carrier** HVAC systems. Under this work, the team used parametric and non parametric models to learn users schedules, patterns of activities and preferences of individuals using statistical learning methods; Also used change detection algorithms to detect a switch in the pattern of activity. As a final stage the team organized a cross company workshop introducing the various researchers and engineers in the organization to human machine interaction usability and applications. The team shared an award for that effort and the success of bringing others in the organization up to speed on this important the research center
- **Fuel cells:** Modeled PC50 fuel cell at **UTC Power** using dynamic regression. Studied reasons for occasional failure of the fuel cells under abrupt power outages or in case of disconnect from the grid. Collected data from the fuel cell and estimated the system bandwidth using system identification techniques. The reason for failure was identified using the model to be cause by the control strategy and corrections on the design were proposed.
- **Unmanned air vehicle:** Under the **Sikorsky Aircraft** research program, explored modifications to the classical Simultaneous Localization and Mapping (SLAM) algorithm to increase robustness of the algorithm to measurement and localization error. Randomized algorithms were proposed and shown to allow recovery from errors of up to 50% in the prior, with an overall confidence driven by the confidence level in the prior.
- **Clustering on large networks:** Improved clustering ability of the wave propagation method with a factor of 3 while decreasing the time for clustering with a factor of 20. The improvement were accomplished by allowing cooperative peak estimation between the nodes of the network.

Technical review committee member

Served as a member of the technical review committee for indoor localization project conducted by UTRC-Ireland. My role included importance evaluation of the research projects conducted by the team in Ireland in the field of indoor localization, as well as the technical soundness of the work. The role also included providing guidance on appropriate approaches to be used as the project progressed.

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

Investigated two different aspects of decision theory on a network:

- **Distributed decision making.** Major contributions:
 1. Provided a novel computational method that allowed exact analysis of the accuracy and time of a network of cooperative agents.
 2. 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.
 3. Showed that the optimal fusion rule varies with the local fusion rules and the network size as well as the desired performance.
- **Cooperative regional source localization.** Major contributions:
 1. Designed distributed algorithms to solve regional localization as a multi-hypothesis problem.
 2. Provided convergence results and performance measures of the suggested algorithms.
 3. Improved the performance of the algorithms by optimally partitioning the environment.

Graduate Research Associate, University of California, Santa Barbara Sep'05-Aug'07

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:

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

Areas of Technical Competence

- **Dynamical Systems:** Control and dynamical systems theory, mathematical modeling and analysis of a variety of dynamical systems (interaction between individuals, biological systems, reactors, compressors, opinions)
- **Learning and data:** Machine learning, statistical learning, decision and detection theory under uncertainty, estimation theory.
- **Computational Sciences:** Systems biology, computational methods, cognitive information processing.
- **Optimization:** Optimal space allocation, distributed algorithms design, optimization theory.
- **Communication and Signal processing:** Control over communication channels, signal processing in control.

Technical Skills

- **Languages:** Fluently speak, read and write: English, French and Arabic.
- **Computer skills:** R, Python, Matlab, Mathematica, Labview, PLC programming.
- **Laboratory skills:** basic knowledge on performing biochemical experiments (CheY) cloning, protein purification, PCR, agarose gel electrophoresis and protein data analysis.

Professional Service

- **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.s
- **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, **Sequential Decision Aggregation: Accuracy and Decision Time for Decentralized SPRT**, *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*, 49(1):178-185, 2013.
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, 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):7-16, 2009.
5. 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*, vol. 25:723-739, 2011.

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 Hagues, 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

Available upon request.