Sandra Hala Dandach

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Summary

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

Education

Ph.D. Mechanical Engineering, University of California, Santa Barbara, CA, USA.   Sep'07- Jun'11
Center for Control, Dynamical Systems and Computation.
Thesis: Distributed decision making: Analysis and applications.
Advisor: Francesco Bullo

M.Sc. Mechanical Engineering, University of California, Santa Barbara, CA, USA.   Sep'05 -Sep'07
Center for Control, Dynamical Systems and Computation.
Thesis: Bacterial competence: stochastic strategies for survival.
Advisor: Mustafa Khammash

M.Sc. Electrical Engineering, University of Iowa, Iowa city, IA, USA.   Sep'03-Aug'05
Thesis: Stability of adaptive delta modulation with and without a forgetting factor.
Advisor: Soura Dasgupta

B.E. Electrical Engineering, American University of Beirut, Beirut, Lebanon.   Sep'98-Jul'02

Work Experience

Senior Data Scientist, Sears Holding Corporation, CA   Jul'13-present

Big Data for optimal customer experience

Use machine learning algorithms to analyze customer data to personalize and improve customer experience in Sears Holdings Corporation. The main goal is to personalize control variables (advertisement, coupons, discounts, pricing, etc.) and ensure higher revenues by increasing customers rate of return and purchase frequency, while increasing company gain margins. Target business units are both in store and online.

1. **Targetted Marketing:** Used random forest to associate customer information and purchase history to departments of interest and suggested improved targetted coupon dispencing.

2. **Individualized dollar to point conversion rate:** Conducted unsupervised learning on customers to identify individualized response to coupons; used system theoretic techniques to estimate functions that capture the response over each group; solved for the rate of conversion of point offers that lead to the same probability of redemption from the dollar offers; whenever data was insufficient, suggested tests to be conducted to gather the needed information.

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

Modeling, learning and analysis in a variety of applications

1. **Compressor map:** Used regression methods and investigated neural networks in modeling the efficiency and mass flow rate of the compressor map in the air bleed system. The learned model is used in predicting the mass flow and efficiency in parts of the map where experimental data is unavailable.

2. **Smart Human Machine Interface:** Learned parametric and non parametric models of 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.

3. **Fuel cells:** Modeled PC50 fuel cell at UTC Power using dynamic regression; Analyzed the model and related occasional failure of the fuel cells under abrupt power outages to the limited control bandwidth.

4. **Unmanned air vehicle:** Improve robustness of the classical Simultaneous Localization and Mapping (SLAM) algorithm using a randomization scheme. Algorithm showed recovery from errors of up to 50% in the prior, with an overall confidence driven by the confidence level in the prior.

5. **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

Acting on the technical review committee for an indoor localization project conducted by UTRC-Irleland. Main role is to evaluate soundness of the technical methods and to provide technical consulting per team's request.

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

Investigated two different aspects of decision theory on a network:

1. Cooperative regional source localization. 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.

Areas of Technical Competence

1. Machine learning, statistical learning, decision and detection theory under uncertainty, estimation theory.

2. Mathematical modeling of a variety of dynamical systems (interaction between individuals, biological systems, reactors, compressors, opinions)

3. Systems biology, computational methods, cognitive information processing.

4. Optimal space allocation, distributed algorithms design, control theory, optimization theory.

5. Control over communication channels, signal processing in control.

Technical Skills

- **Languages:** Fluently speak, read and write: English, French and Arabic.

- **Computer skills:** Mathematica, Matlab, Labview, R, Python, PLC programming, C++ (basic).

- **Laboratory skills:** basic knowledge on performing biochemical experiments (CheY) cloning, protein purification, PCR, agarose gel electrophoresis and protein data analysis.

- **Personal skills:** Very active, very fast learner, great team player and leader, great presentation skills.

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.

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, **Accruacy 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.