COLLEGE OF ENGINEERING AND COMPUTER SCIENCE
FLORIDA ATLANTIC UNIVERSITY

Announces the Ph.D. Dissertation Defense of

Prasanth Ganesan

for the degree of Doctor of Philosophy (Ph.D.)

"Development of an Algorithm to Guide a Multi-polar Diagnostic Catheter for Identifying the Location of Atrial Fibrillation Sources"

June 26, 2019 9:00 a.m.
Engineering East, Room 405
777 Glades Road
Boca Raton, FL

DEPARTMENT:
Computer & Electrical Engineering and Computer Science

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PH.D. SUPERVISORY COMMITTEE:
Behnaz Ghoraani, Ph.D., Chair
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Borko Furht, Ph.D.
Zvi Roth, Ph.D.

ABSTRACT OF DISSERTATION
Development of an Algorithm to Guide a Multi-polar Diagnostic Catheter for Identifying the Location of Atrial Fibrillation Sources.

Catheter ablation therapy with electrical isolation of pulmonary veins (PVs) remains the cornerstone treatment procedure for patients with drug-refractory persistent or high-burden paroxysmal atrial fibrillation (AF). However, standalone PV isolation procedure has only sub-optimal success rates, and some ablation techniques aim to improve the success rates by targeting the signal sources present in the atrial wall, namely rotational sources and point sources. In the current clinical scenario, accurate localization of these sources is a major challenge because current methods use low-resolution basket-type catheters which have several limitations and risks. In this thesis, a novel algorithm is presented, that uses a conventional high-resolution catheter to localize a rotational or a point source in the patient's atrium. The algorithm applies signal processing and pattern recognition techniques on bipolar electrogram signals recorded at a location of the endocardium. It automatically determines the next location to navigate the catheter to, as well as builds a color-coded map over the 3D anatomy map of the atrium, thereby providing visual guidance

to the clinicians on the AF source location. The algorithm was evaluated using both simulated and clinically recorded AF cases. The developed low-cost and low-risk algorithm could play a significant role in improving the procedure success and the quality of life of AF patients.

BIOGRAPHICAL SKETCH
Born in India
B.E., Anna University, Chennai, Tamil Nadu, India, 2013
M.S., Rochester Institute of Technology, Rochester, New York, 2015
Ph.D., Florida Atlantic University, Boca Raton, Florida, 2019

CONCERNING PERIOD OF PREPARATION
& QUALIFYING EXAMINATION

Time in Preparation: 2015 - 2019

Qualifying Examination Passed: Spring 2016

Published Patents:

1. Ghoraani, B., **Ganesan, P**. "Systems and Methods for Localizing Signal Sources Using Multi-Pole Sensors", US Patent (pending) Application Serial No. 15/595110, Filed May 2017
2. Ghoraani, B., **Ganesan, P**. "Systems and Methods for Guiding a Multi-Pole Sensor Catheter to Locate Cardiac Arrhythmia Sources", US Patent (pending) Application Serial No. 15/727393, Filed Oct. 2017

Published Book Chapter:

1. **Ganesan, P**., Sterling, M., Ladavich, S., Ghoraani, B. "Computer-Aided Clinical Decision Support Systems for Atrial Fibrillation", Book title: Computer-aided Technologies - Applications in Engineering and Medicine, InTech, 2016

Published Papers:

1. **Ganesan, P**., Cherry, E.M., Huang, D., Pertsov, A.M. and Ghoraani, B., "Locating Atrial Fibrillation Rotor and Focal Sources Using Iterative Navigation of Multipole Diagnostic Catheters", Cardiovascular Engineering Technology Journal, 2019
2. **Ganesan, P**., Salmin, A.J., Cherry, E.M., Huang, D., Pertsov, A.M. and Ghoraani, B., "Iterative Navigation of Multipole Diagnostic Catheters to Locate Atrial Fibrillation Rotor Sites", Journal of Cardiovascular Electrophysiology, 2019
3. **Ganesan, P**., Zilouchian, H., Cherry, E.M., Pertsov, A.M. and Ghoraani, B., "Developing an Iterative Tracking Algorithm to Guide a Catheter Towards Atrial Fibrillation Rotor Sources in Simulated Fibrotic Tissue", Computing in Cardiology Conference (CinC), 2018
4. **Ganesan, P**., Cherry, E.M., Pertsov, A.M. and Ghoraani, B., "Development of a Rotor-Mapping Algorithm to Locate Ablation Targets During Atrial Fibrillation", Life Sciences Conference (LSC), IEEE, 2018
5. **Ganesan, P**., Shillieto, K.E. and Ghoraani, B., "Simulation of Spiral Waves and Point Sources in Atrial Fibrillation with Application to Rotor Localization", Computer-Based Medical Systems (CBMS), Conference of the IEEE, 2017
6. **Ganesan, P**.*, Salmin, A.J., Cherry, E.M. and Ghoraani, B., "Development of a Novel Probabilistic Algorithm for Localization of Rotors during Atrial Fibrillation", Engineering in Medicine and Biology Society (EMBC), 38th Annual International Conference of the IEEE, 2016
7. Salmin, A.J., **Ganesan, P**., Shillieto, K.E., Cherry, E.M., Pertsov, A.M., Huang, D. and Ghoraani, B., "A Novel Catheter-Guidance Algorithm for Localization of Atrial Fibrillation Rotor and Focal Sources", Engineering in Medicine and Biology Society (EMBC), 38th Annual International Conference of the IEEE, 2016
8. Shillieto, K.E., **Ganesan, P**., Salmin, A.J., Cherry, E.M., Pertsov, A.M. and Ghoraani, B., "Catheter Simulator Software Tool to Generate Electrograms of Any Multi-polar Diagnostic Catheter from 3D Atrial Tissue", Engineering in Medicine and Biology Society (EMBC), 38th Annual International Conference of the IEEE, 2016
   * Awarded the best student paper open finalist - 15 out of 258 nominations selected internationally

Accepted Papers:

1. **Ganesan, P**., Rajaraman, S., Long, R., Ghoraani, B., Antani, S., "Assessment of Data Augmentation Strategies Toward Performance Improvement of Abnormality Classification in Chest Radiographs", accepted in Engineering in Medicine and Biology Society Conference (EMBC), IEEE, 2019
2. **Ganesan, P**., Xue, Z., Singh, S., Long, R., Ghoraani, B., Antani, S., "Performance Evaluation of a Generative Adversarial Network for Deblurring Mobile-phone Cervical Images", accepted in Engineering in Medicine and Biology Society Conference (EMBC), IEEE, 2019

Awards Received:

2019   The Provost Honorary Recognition for Publishing, Student Publication Ceremony at Florida Atlantic University

2019   Impactful Bio-engineering Research Award $2,500, The Gangal Foundation and COECS at Florida Atlantic University

2017   First place winner, 3-Minute Thesis Competition by COECS, Florida Atlantic University

2017   Travel award $600 for Heart Rhythm Society Conference at Chicago, GPSA Society at Florida Atlantic University

2016   Selected as an IEEE Engineering in Medicine and Biology Society Student Paper Competition Finalist

2016   Awarded at the IEEE Engineering in Medicine and Biology conference for the development of a novel probabilistic algorithm for localization of rotors during atrial fibrillation. Included a travel award of $500 to Orlando, FL