Abhishek Kulkarni

Curriculum Vitae

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Research Interests

- Formal Methods for Robotics.
- Automatic Controller/Strategy Synthesis for Reactive Systems.
- Game and Hypergame Theory in Logic and Automata Theory.
- Autonomous Mobile Robots.
- Mission/Task Planning.
- Algorithmically Complete Motion Planning.

Education

Aug'16 - Present **M.S./Ph.D. in Robotics Engineering**,
Worcester Polytechnic Institute (WPI), Worcester, MA, USA, **_CGPA_** *– 3.61/4.0.*

Aug'12 - May'16 **Bachelor of Technology in Electronics and Telecommunication Engineering**,
Vishwakarma Institute of Technology (VIT), Pune, India, **_CGPA_** *– 8.72/10.0.*

Research Experience

2017-2019 **Relation between Hypergames and Synthesis under Information Asymmetry**,
Prof. Jie Fu (WPI).
- Showed that two-player games under information asymmetry with linear temporal logic (LTL) objectives can be modeled as hypergames.
- Defined *opportunistic synthesis* as an approach to synthesize less-conservative winning strategy in the hypergame for a player who is aware of other player's misperception of his/her objective.

2016-2017 **Compositional Reactive Synthesis**,
Prof. Jie Fu (WPI).
- Proposed an efficient set-based algorithm to solve compositional synthesis of controllers for reactive games with linear temporal logic (LTL) specifications.

2014-2016 **Algorithmically Complete Motion Planning**,
Prof. Pushkar S. Joglekar (VIT).
- Extended JM Lien's work to develop an $O(N \log N)$ algorithm in 2D (resp. $O(N^2)$ algorithm in 3D) to compute point-based Minkowski sum of two arbitrary polygon (resp. polyhedra) using concept of concave hull.

2013-2014 **Big-Data Management in a Industrial Cyber-Physical System**,
Prof. Satish R. Inamdar (VIT).
- Characterized how big-data analysis techniques become relevant in relatively small-scale cyber-physical systems due to existing concurrency and parallelism of control processes.

Industry Experience

Aug'17 -
Dec'17 **Robotics Research Intern**, *NodeIn Inc.*.
○ Developed provably-correct motion planning algorithm for quadcopter traveling in urban environment using formal methods approach.

May'17 -
Aug'17 **Hardware-Software Intern**, *Mathworks*.
○ Extended MATLAB's hardware support for Arduino with additional sensors.

Publications

2019 **Abhishek N. Kulkarni** and Jie Fu, *Opportunistic Synthesis in Reactive Games under Information Asymmetry*, Conference on Decision and Control (CDC), 2019. (accepted)

2018 **Abhishek N. Kulkarni** and Jie Fu, *A Compositional Approach to Reactive Games under Temporal Logic Specifications*, Annual American Control Conference (ACC), 2018.

2015 Siddharth Nitin Patki, Madhura Joshi and **Abhishek N. Kulkarni**, *Dot Matrix Text Recognition for Industrial Carton Classification*, International Conference on Industrial Instrumentation and Control (ICIC), 2015.

2014 **Abhishek N. Kulkarni**, Anita S. Joshi and Satish R. Inamdar , *Big Data Management of a Cyber-Physical Multi-location Chemical Factory*, International Journal of Industrial Electronics and Electrical Engineering (IJIEEE), vol. 2, issue 8, pp. 9-14, Aug. 2014.

Teaching and Leadership Roles

Fall'19 Guest lecturer for *RBE595: Formal Method in Robotics* course for Prof. Jie Fu.

Spring'18 TA for *ECE2799: Electrical and Computer Engineering Design* in Term-B for Prof. Shamsur Mazumder.

Spring'18 TA for *ECE2019: Sensors, Circuits and Systems* in Term-A for Prof. Shamsur Mazumder.

Spring'17 Talk on *An Informal Introduction to Formal Methods* for the robotics honor society, Rho-Beta-Epsilon.

Summer'15 Designed and taught *Embedded Systems Programming with Arduino* at Cognitive Robotics and Intelligent SysTems Lab (CRISTL) group at VIT.

Fall'15 Organized a 6-day workshop on *Image Processing using OpenCV* by Anand Muglikar as part of CRISTL.

Summer'14 Founded and led CRISTL group at VIT with focus on theoretical aspects of robotics.

Skills

Languages Python, C/C++, Embedded C, VB.NET, Shell Script.

Tools Robot Operating System (ROS), Gazebo, OpenCV, MATLAB, Visual Studio, Unity3D, LaTeX, GitHub.

Embedded Platforms AVR, BeagleBone Black, Raspberry Pi, Arduino, NVidia Jetson TX2.

Selected Honors/Awards

2014-2016 **Board of College and University Development (BCUD) Research Grant** for developing a Low-cost Educational Robotics Platform: Curio.