

## Series of ARAS Public Webinars By ARAS Alumni

# Safe Reinforcement Learning (SRL) Using Control Barrier Functions

### Invited Speaker



### Zahra Marvi, Ph.D. Candidate

Zahra is a Ph.D. candidate with the department of Electrical and Computer Engineering at Michigan State University. Prior to that, she was with Advanced Robotics and Automated Systems (ARAS), K. N. Toosi University of Technology, Tehran, Iran; where she received her B.Sc. in Electrical Engineering in 2013 and her M.Sc. in Mechatronics Engineering in 2016. Zahra's research interests include nonlinear control, reinforcement learning, multi-agent systems and robotics. Her current research focus is to design controllers for safety-critical systems under model and environmental uncertainty.

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### Abstract

This talk presents a method to learn **barrier-certified** safe controllers for **safety-critical** systems while providing an optimal performance with the focus on reinforcement learning approach. The problem describes designing optimal controllers for systems with unknown dynamics through the interaction while safety specifications of the system such as state constraints must be satisfied. We first start by reviewing the basics of **reinforcement learning** in control such as the overall framework, Bellman equation, actor/critic approximations and sequential improvement of controller by means of reducing the prediction error. Then, different types of control barrier functions and their application for restricting the states of the system within a desired safe region and therefore safety guarantee are discussed. The **safe reinforcement learning** problem is then formulated by means of **control barrier functions** to have a safe performance. **Safety, stability and optimality** of the proposed method are discussed and finally the **off-policy** reinforcement learning algorithm to implement the proposed method is presented.

### Date & Time

Date: Monday, May 31, 2021 (10 Khordad 1400)

Time: 18:00-19:30 (+4:30 GMT Tehran local time)

9:30-11:30 (-4:00 GMT Canada Eastern Time Zone)

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