

Clarkson University
Department of Chemical and Biomolecular Engineering
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“Towards Safe Learning-based Model Predictive Control for Effective Dose Delivery in Plasma Medicine”

Prof. Ali Mesbah
Department of Chemical and Biomolecular Engineering
University of California Berkeley

Plasma medicine hinges on local generation and delivery of a variety of therapeutic agents including electric fields, reactive chemical species, and thermal effects. With an increasing number of clinically approved atmospheric-pressure plasma devices, there is growing evidence for the effectiveness of plasma medicine in alternative and complementary therapies such as reduction of head and neck cancer and accelerated healing of chronic wounds. However, safe and effective operation of hand-held atmospheric-pressure plasma devices is highly sensitive to the intrinsic variability of plasma characteristics, as well as to exogenous disturbances such as variations in the physical and chemical properties of a target substrate. Key challenges in feedback control of these plasma devices arise from the need to: (i) handle the nonlinear, multivariable nature of plasma dynamics, (ii) retain the system operation in a constrained region for safe and reliable operation, and (iii) realize multiple (possibly conflicting) plasma dose delivery objectives. In this talk, we will demonstrate the promise of learning-based predictive control strategies for safe, reproducible, and therapeutically effective application of atmospheric-pressure plasma jets for thermal dose delivery in plasma medicine.

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<https://clarkson.zoom.us/j/95125586292>



Ali Mesbah is Associate Professor of Chemical and Biomolecular Engineering at the University of California at Berkeley. Before joining UC Berkeley, Dr. Mesbah was a senior postdoctoral associate at MIT. He holds a Ph.D. degree in Systems and Control from Delft University of Technology. Dr. Mesbah is a senior member of the IEEE and AIChE. He serves on the IEEE Control Systems Society Conference Editorial Board and IEEE Control Systems Society Technology Conference Editorial Board, and is a subject editor of Optimal Control Applications and Methods and IEEE Transactions on Radiation and Plasma Medical Sciences. Dr. Mesbah is recipient of the Best Application Paper Award of the IFAC World Congress in 2020, the AIChE's 35 Under 35 Award in 2017, the IEEE Control Systems Outstanding Paper Award in 2017, and the AIChE CAST W. David Smith, Jr. Publication Award in 2015. His research interests lie at the intersection of optimal control, machine learning, and applied mathematics, with applications to learning-based analysis, diagnosis, and predictive control of materials processing and manufacturing systems.