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Predictive Control for Effective Dose Delivery in Plasma Medicine

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Abstract:
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 and predictive control strategies for safe, reproducible, and therapeutically effective application of atmospheric-pressure plasma jets for thermal dose delivery in plasma medicine.