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## Optimal charge/discharge profiles of mechanically constrained lithium-ion batteries

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### ABSTRACT

The cost and safety related issues of lithium-ion batteries require proactive charge and discharge profiles that can efficiently utilize the battery. Detailed electrochemical engineering based models that incorporate all of the key physics affecting the internal states of a lithium-ion battery are modeled using a system of coupled nonlinear partial differential equations. Careful choice of numerical discretization schemes and mathematical reformulation approaches can reduce the computational cost of these models to implement them in control relevant applications. The progress made in understanding the capacity fade mechanisms has paved the way for inclusion of that knowledge in deriving optimal charging/discharging profiles. Derivation of optimal charging/discharging profiles using physics based models enable us to provide constraints that can minimize local nonideal behavior and maximize efficiency locally and globally. This presentation will discuss derivation of optimal charging/discharging profiles which restrict various driving forces that accelerate capacity fade in a battery (e.g., temperature rise, over-potential for parasitic side reactions, intercalation induced stresses in solid phase) with minimal compromise on the amount of charge stored.