**Title: Modeling and control challenges in roll-to-roll transport of strip in metal peeling**

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Abstract: Strip metal manufacturing using conventional rolling processes is known to be energy and carbon emission intensive as it involves multiple hot and cold rolling stages to produce coils of thin metal strips. A novel clean energy alternative to conventional rolling technology is metal peeling which can produce a continuous metal strip by machining a thin surface layer directly from a rotating feedstock and coupling the produced strip into a roll-to-roll system for transport, finishing, and coiling. However, integrating metal peeling with a tensioning and coiling roll-to-roll system presents several challenges. For example: (1) strip thickness is a function of the downstream tension applied on the peeled strip as it is transported on rollers to the coiler; (2) workpiece characteristics and upstream peeling parameters affect the strip properties, such as surface quality and geometry; and (3) capturing the initial peeled strip, splicing, and threading it into the roll-to-roll system.

Governing equations for strip tension and transport speed are available for unwinding from a roll, transport through finishing processes, and winding on to a coil. In contrast, there are no available models that describe the peeling process coupled with transport of the peeled strip under tension through the roll-to-roll system. In addition to the modeling challenges, there are control challenges associated with simultaneously controlling strip tension and strip transport speed at desired reference values; this requires development of a model-based control system to address the interaction between the peeling process parameters and transport variables. Specifically, inhomogeneous workpiece characteristics manifest as thickness variations and disturbing forces during peeling, making tension and speed regulation even more challenging; a requirement of this control system is in the ability to mitigate the disturbing forces on the strip due to the peeling process and its transport. This presentation will describe (1) the challenges associated with modeling and control of this new manufacturing system; (2) provide possible approaches for developing the governing equations for key process and transport variables; and (3) suggest possible model-based control systems for producing quality strip and efficient coiling of finished strip.

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