Instability in lateral dynamics of a metal strip in cold rolling

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The sudden deviation of the strip from the direction of rolling, known as strip track-off, is a serious operational problem in metal rolling that could lead to catastrophic consequences, such as strip chew-up and mill crash. While the causes of instability in the lateral dynamics of a so called tail out scenario (when the unconstrained tail of the strip moves through the reduction rolls) are well understood, the causes of lateral instability during the rolling of the strip constrained upstream in the tension producing device or un-coiler have not been explained to date.

This paper studies the lateral dynamics of the strip constrained upstream. A mathematical model of the first stand of a cold reduction mill is formulated. A distinctive feature of the model is the inclusion of a simplified model of strip buckling between the reduction stand and the upstream tension device.

Numerical analysis of the model reveals that buckling changes the nature of strip lateral dynamics. While, in the absence of strip buckling, the dynamics is inherently stable, the buckling of the strip in combination with the asymmetry in rolling conditions could lead to instability. It has been found that the instability is associated with a certain critical level of the asymmetry in rolling conditions, which provides an explanation of a sudden catastrophic track-off when this critical level is reached.