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DYNAMICS OF AN ELASTIC WEB IN ROLL-TO-ROLL SYSTEMS USING FINITE ELEMENT METHOD

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Roll-to-Roll systems handling web material such as papers, polymers, textiles or metals are very common in the industry. Printing, coating and drying are examples of operations that can be performed in different sections of a web line. Web handling systems are recently used to produce new technologies such as semi-conductors, thin solar panels, printed electronics, etc. Web tension and speed are two key variables that need to be monitored and controlled in order to achieve the expected final product quality.

One of the main objectives in web handling machinery is to reach an expected web speed while maintaining the web tension within an acceptable range around the tension reference in the entire processing line. But even if those parameters are properly controlled it does not mean that it will have no dysfunctions because models that are usually used for the tuning of machineries in web speed or tension are only one-dimensional [4]. They do not take in account cross-machine components of the elastic web dynamics and therefore several three-dimensional mechanical phenomena initiated by these lateral components of the web dynamics can appear in a roll-to-roll production line. Usually, these phenomena have a negative impact on the web quality and can be referenced as defects (for example wrinkles). In addition, as in every industrial sector, the seek of performances obliged roll-to-roll systems to be faster, with a better accuracy, to have the capacity to produce very thin (or thick) or very elastic (or rigid) products,etc.

To answer these problematics and optimize roll-to-roll systems, it is necessary to develop new models. Industrial web handling production lines are also complex because their are of a large scale, multibody and the contact web/roller is difficult to analyse. One way to replicate this complexity is to use a finite element [1] model with the help of an analytical

theory which has shown good result [2] [3].

This paper focuses on finite element modeling of roll-to-roll systems in order to study the elastic web dynamics. The main objective is to simulate web wrinkles by adjusting mechanical parameters, boundary and initial conditions. These parameters and conditions are given by physical laws and experimental data measured on real industrial production lines. The major part of the study deals with roll-to-roll systems having a misaligned roller in order to validate the finite element model and to study the influence of parameters.

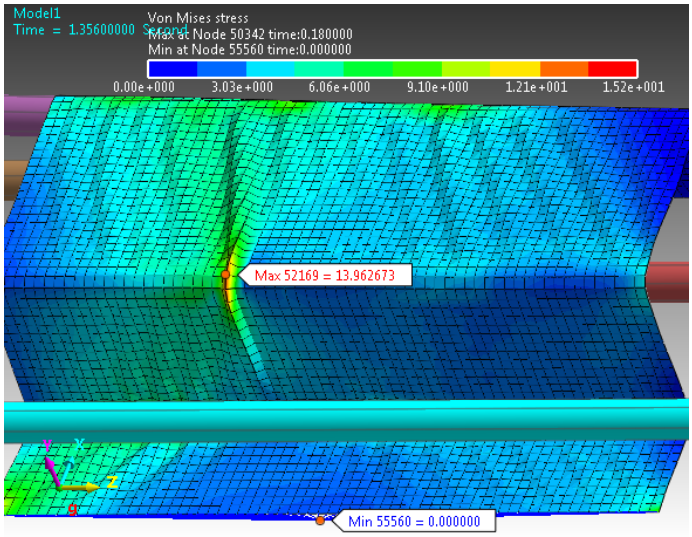

Figure 1: ELASTIC WEB DYNAMICS IN ROLL-TO-ROLL SYSTEM: APPEARANCE OF A WRINKLE

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