MODELLING AND CONTROL OF A HOT ROLLING MILL

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Abstract **– *In this paper, a real application of optimal control of a hot rolling mill is presented. It is used the state space model formulation in the minimization of the strip thickness variations. It is presented the simulation results of the control model, which is compared with industrial real data from process controled by traditional techniques. The results of the simulations lead to a less output thickness variations compared with the real industrial data.***

Keywords **– *optimal control, modelling, hot rolling mill.***

I. INTRODUCTION

In this work, a thickness output control for a strip rolling mill process is proposed. The proposed scheme has the knowledge that permits the application of optimal control techniques.

It was developed a versatile environment for simulations that was used in the analysis the behaviour of a rolling stand. The results was used for validation compared with real rolling stand data .

The simulation is an important tool for simplified dynamic analysis of a rolling mill Stand, allowing easier the controllers validation.

In this introduction the control problem is described. The following topics present the conventional control, the optimal control structure, the optimal control structure with the integral action proposed and results of the proposed controller compared to real data.

The rolling mill process consists of introducing a strip inside two rotating rolls causing a permanent deformation in this strip, it is called thickness reduction. The stands, and rotary rolls, are the machines that make the rolling mill process. A Tandem Rolling Mill is a set of rolling mill stands. Figure 1 shows a scheme of two simple rolling mill stands with four rolls each one and with thickness adjustment systems by screws positioners. The rolls in contact with the strip are the work rolls. The rolling mill stands are constituted by four rolls, two work rolls and two of back-up. In this paper the rolling mill physical phenomena is done by the work rolls The strip plate from the previous processes (flat product or a coil), is introduced in the gap of the work rolls, which is smaller than the thickness of the strip. This gap is determined by set point of the screws that positions the rolls.

These rolls drag the strip to the Stand roll bite, reducing its thickness. This strip has to leave the actual stand and enter in the next until the desired thickness is reached and is coiled in the output of the last Stand.

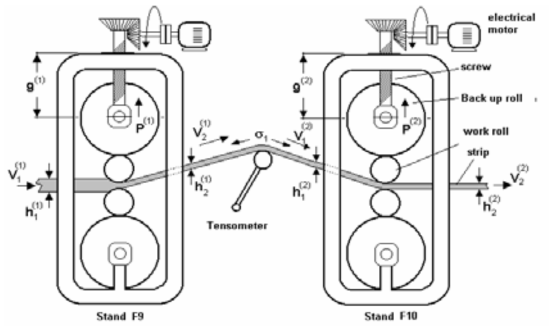

Fig. 1: Rolling mill stands escheme

The main motivation of this work is the reduction of the output thickness variations of any of two input process variables disturbance: strip temperature and input strip thickness. Fig. 2 shows three graphics of real rolling mill process. In Fig. 2 (a) we observe the rolling force and the cold zones indicated by arrows, that are due to skid marks at the furnaces. In Fig. 2 (b) we can see the temperatures and in Fig. 2 (c) the consequent exit thickness.

These cold zones have greater deformation resistance and increases the rolling mill force in the stand. This variations in the rolling mill force produce variations in the stand stretching, leading to variations in the output strip thickness at the stand.

Observing the output temperature of the rolling mill stand, it can be seen low temperature zones that are the skid marks previously mentioned. On the other hand, from the beginning to the end of the process a decreasing temperature is observed. This thermal lose produces a proportional increasing in the rolling force and in the output strip thickness as presented in Fig. 2 (c), being the temperature variations and the input thickness the mainly responsables of the variations in the rolling force altering the output strip thickness .

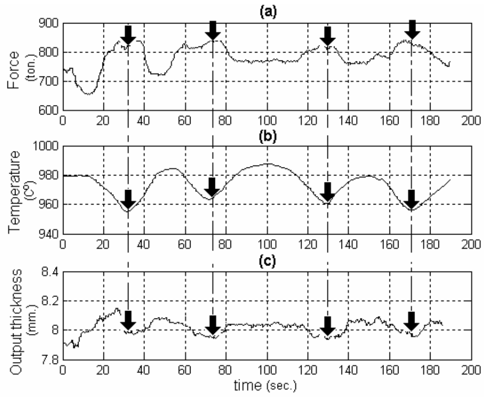

Fig. 2: Strip cold points.