INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: Inverse Estimation of Material Parameters, Convective Heat Transfer Coefficients and Friction in Warm Flat Rolling

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SHORT ABSTRACT

The estimation of material parameters, heat transfer coefficients and the coefficient of friction plays an important role in the modelling of the rolling process. Inverse method of estimating the material parameters avoids conducting separate experiments during rolling. Modelling of rolling process requires a realistic model of deformation and thermal analyses. In the present thesis, inverse methods are proposed for estimating various parameters of the warm flat rolling process by measuring the temperature and slip. The proposed methodologies are tested in a laboratory rolling mill. For making the direct model to find out the temperature in rolling, finite element and analytical methods are used. A two-dimensional steady-state thermo-mechanical analysis of the flat rolling comprises two modules—deformation module and thermal module. Deformation module uses finite element method (FEM) based on Eulerian flow formulation. Thermal module uses both FEM and analytical methods. Three methods have been proposed for the estimation of steady-state temperature in the roll including fast finite element method. For estimating the temperature of strip, analytical as well as FEM has been used. The FEM results ensure the accuracy of the analytical methods. A transient thermal analysis of warm flat rolling is carried out and validated with in-house experiments. This analysis is needed for inverse estimation of thermal parameters. In a nutshell, thesis presents inverse methods based on temperature and slip measurement are as follows. Firstly, the coefficient of friction is estimated based on the exit strip temperature measurement, once the material properties of the strip and the roll are known. Secondly, a heuristic based methodology for the inverse estimation of mechanical properties and the coefficient of friction by measuring the temperature at one specified location and slip is proposed. Experimental validation is also carried out. Thirdly, a method for estimating the thermal parameters based on the measurement of temperature at two specified locations at various times is proposed. A sensitivity study is carried out to find the uniqueness in the estimated parameters.