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Physical Processes Simulation and Identification of Implicit Mathematical Models

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ABSTRACT

The complex physical problems arise in the modeling of the different aspects of rolling process grasping many branches of mechanics and mathematics. The problem is to solve distributed differential equations such as system of elastic-plastic media equations with heat transfer equation (casting — solid and liquid phase, rolling — solid phase, roll and strip thermal state, etc.), equilibrium equation in elastic theory (mechanical equipment stability under the loading), system of many (30–40) ordinary differential equations (dynamic system analysis — main drive of rolling stand in non-steady rolling stages). We have solved some of these problems by the aid of FEM and other calculation methods [1].

Each mathematical model of a process includes the series of parameters, the value of that may be changed in definite limits. If the model is adequate to physical process essence then there are the optimal parameter values, when the model corresponds best to the real process. Optimal parameters finding for the models with ordinary and distributed differential equations leads to the solving of Implicit Identification problems [2], founded at Least Square Method. Identification process was investigated for the heat transfer equation for the axisymmetric temperature field with boundary conditions of "edge film" type; some film coefficients were the identification parameters. The next model for identification was the dynamic system equation of rotated masses, where link mass stiffnesses were the identification parameters. Some essential advantages of Gauss-Newton and Levenberg-Marquardt optimization methods was discovered in comparison with gradient methods.

References

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