Prediction of wire rod temperatures under different industrial process conditions: Application of reduced order modelling for a fast prediction

Elena Martín[1,3], Fernando Varas[2], Iván Vieitez [1,4]
[1]ITMATI, Campus Vida, Santiago de Compostela, Spain
[2]Departamento de matemática Aplicada a la ingeniería aeroespacial, E.T.S.I. Aeronáutica y del Espacio, Universidad Politécnica de Madrid, Madrid, Spain
[3]Escola de Enxeñería Industrial, Universidade de Vigo, Vigo, Spain
[4]Escola de enxeñaría de telecomunicación, Universidade de Vigo, Vigo, Spain

The number of operational variables that determines the cooling process of steel wire, given by the conveyor velocity and the different fan sections powers (controlled independently), lead to a dependency of the cooling on a high multidimensional parameter space whose potential combinations are impossible to be analyzed, either experimentally or by numerical simulation of a thermal-metallurgical model. To tackle this problem, an efficient strategy, based on the use of Higher Order Singular Value Decomposition (HOSVD), is presented. The approach presented permits to predict quite accurately the cooling curve for any combination of the process parameters. Fast on-line predictions of the cooling rates allow incorporating accurate modelling results in many Engineering tools, such as model predictive control algorithms or planting simulation software.

REFERENCES

[1] E. Anelli, Application of mathematical modelling to hot rolling and controlled cooling of wire rods and bars, ISIJ Int. 32 (3) (1992) 440–449.

[2] I. Viéitez, F. Varas, E. Martín, An efficient computational technique for the prediction of wire rod temperatures under different industrial process conditions, Applied Thermal Engineering 149 (2019) 287-297.

[3] G. Berkooz, P. Holmes, J.L. Lumley, The proper orthogonal decomposition in the analysis of turbulent flows, Annu. Rev. Fluid Mech. 25 (1993) 539–575.

[4] R. Everson, L. Sirovich, Karhunen-Loeve procedure for gappy data, J. Opt. Soc. Am. A 12 (8) (1995) 1657–1664.

[5] L. De Lathauwer, B. de Moor, J. Vandewalle, A multilinear singular value decomposition, SIAM J. Matrix Anal. Appl. 21 (2000) 1253–1278.

[6] E. Martín, M. Meis, C. Mourenza, D. Rivas, F. Varas, Fast solution of direct and inverse design problems concerning furnace operation conditions in steel industry, Appl. Therm. Eng. 47 (2012) 41–53.