Enthalpy-based feedback control algorithms for the Stefan problem with application to continuous steel casting

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Abstract— Although a relatively new technology, continuous casting is the most common method of casting steel today, producing about 95% of steel world-wide. After a brief introduction to a continuous casting process, this talk presents derivation of a control law for full-state feedback control of the single-phase Stefan problem used as a continuous casting process model. A conceptually novel controller design approach is proposed for this problem, with the control law chosen to ensure exponential stability of the average enthalpy. The latter fact is proven to guarantee asymptotic convergence of both the temperature field and the solidification front position to a desired reference. A plausible output feedback control algorithm is also given that demonstrates good behavior in simulation.

Joseph Bentsman received the Electrical Engineering diploma from Byelorussian Polytechnic Institute, Minsk, Belarus in 1979 the Ph.D. degree in electrical engineering from the Illinois Institute of Technology in 1984. He spent a year as a Lecturer and a Postdoctoral Research Fellow in the Department of Electrical Engineering and Computer Science, University of Michigan, Ann Arbor, MI. At present, he is Professor in the Department of Mechanical Science and Engineering, University of Illinois at Urbana-Champaign. He has authored over 60 journal and over 100 conference papers in various areas of control theory and practice. Dr. Bentsman is a recipient of the 1989 National Science Foundation Presidential Young Investigator Award in Dynamic Systems and Control. He served as an associate editor of the *ASME Journal of Dynamic Systems, Measurement and Control* and is currently on the editorial board of *Nonlinear Phenomena in Complex Systems.* He is an ASME Fellow.