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Inverse Engineering

George S. Dulikravich[1], Helcio R. B. Orlande[2] and Brian H. Dennis[3]

[1] Florida International University, Department of Mechanical & Materials Eng.
10555 West Flagler Street, Room EC 3474, Miami, Florida 33174, U.S.A.
dulikrav@fiu.edu

[2] Federal University of Rio de Janeiro, Department of Mechanical Eng., COPPE,
Cid. Universitaria, Cx. Postal 68503, Rio de Janeiro, RJ, 21941-972, Brazil
helcio@serv.com.ufrj.br

[3] Department of Mechanical and Aerospace Eng., University of Texas at Arlington,
Arlington, Texas 78712, U.S.A.
dennis@mae.uta.edu

ABSTRACT

Inverse problems are rapidly becoming a multi-disciplinary field with many practical engineering applications. The objective of this lecture is to present several such multi-disciplinary concepts and applications. In some examples, sophisticated regularization formulations were used. In other examples, different optimization algorithms were used as tools to solve *de facto* inverse problems. Due to the mathematical complexity of these multi-disciplinary and often multi-scale inverse problems, the most widely acceptable formulations eventually result in a need for minimization of a certain norm or a simultaneous extremization of several such norms. These single-objective and multiobjective minimization problems are then solved using appropriate robust evolutionary optimization algorithms. Specifically, we focus here on inverse problems of determining spatial distribution of a heat source for specified thermal boundary conditions, finding simultaneously thermal and stress/deformation boundary conditions on inaccessible boundaries, and determining chemical compositions of steel alloys for specified multiple properties.

References

[1] M.N. Özisik, HRB Orlande, Inverse Heat Transfer: Fundamentals and Applications, Taylor & Francis, New York, NY, USA, 2000.

[2] P.M.P. Silva, H.R.B. Orlande, M.J. Colaco, P.S. Shiakolas, G.S. Dulikravich, Estimation of Spatially and Time Dependent Source Term in a Two-Region Problem. In Proceedings of the 5th International Conference on Inverse Problems in Engineering: Theory and Practic (Lesnic, D. ed.) July 11-15, 2005, Cambridge, United Kingdom

[3] B.H. Dennis, G.S. Dulikravich, Z.-X. Han, Determination of Temperatures and Heat Fluxes on Surfaces and Interfaces of Multi-domain Three-Dimensional Electronic Components. ASME Journal of Electronic Packaging, Vol. 126, No. 4, December 2004, pp. 457-464.

[4] B.H. Dennis, G.S. Dulikravich, S. Yoshimura, A Finite Element Formulation for the Determination of Unknown Boundary Conditions for Three-Dimensional Steady Thermoelastic Problems. ASME J. of Heat Transfer, Vol. 126, February 2004, pp. 110-118.

[5] I.N. Egorov-Yegorov, G.S. Dulikravich, Inverse Design of Alloys for Specified Stress, Temperature and Time-to-Rupture by Using Stochastic Optimization. International Symposium on Inverse Problems, Design and Optimization – IPDO (Eds: Colaco, M., Orlande, H., Dulikravich, G.), Rio de Janeiro, Brazil, March 17-19, 2004.