Proceedings of the 4th International Engineering Optimization Conference 2014 (EngOpt2014), Instituto Superior Tecnico, Lisbon, Portugal, 8-11 September 2014

Simultaneous boundary value and material parameter estimation using imperfect compression data

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Abstract

Data is available for different hard metal samples tested in compression using a modified tensile test specimen. Three strain gauges were placed 120 degrees apart around the circumference of the centre of the test section. The spread of the strain data obtained from these tests indicate non-uniform compression. In this paper, the benefits of surrogate modelling is investigated using a virtual experiment with parameterised displacement boundary condition that mimics the responses observed in experimental data. The known boundary condition and material parameter values used to perform the finite element analysis in the virtual experiment allows investigation on the accuracy of the parameter identification strategies employed. The unknown material parameters and boundary conditions are first sampled within a reasonable range using a Latin hypercube. Finite element simulations are performed for each sample point and radial basis function interpolation is used to approximate the error function across the design space. A global optimisation algorithm is used to minimise the error function. The associated parameters can then be compared to the known real solution. In another surrogate modelling approach, the interpolation is set up using the full data set obtained from all sample points. Radial basis function interpolations are set up for each of the unknown parameters as output, using the data as input. Now, given the virtual data set as input, each parameter is simply determined by evaluating the associated radial basis function. Sensitivities are also investigated for both strategies by applying 2% random noise to the virtual experiment data. This is done to investigate the effect of noise on the parameter estimation since the real experimental data would contain some noise.