World Academy of Science, Engineering and Technology
International Journal of Mathematical and Computational Sciences
Vol:14, No:12, 2020

Probability-Based Damage Detection of Structures Using Kriging Surrogates and Enhanced Ideal Gas Molecular Movement Algorithm

Authors : M. R. Ghasemi, R. Ghiasi, H. Varaee

Abstract : Surrogate model has received increasing attention for use in detecting damage of structures based on vibration modal parameters. However, uncertainties existing in the measured vibration data may lead to false or unreliable output result from such model. In this study, an efficient approach based on Monte Carlo simulation is proposed to take into account the effect of uncertainties in developing a surrogate model. The probability of damage existence (PDE) is calculated based on the probability density function of the existence of undamaged and damaged states. The kriging technique allows one to genuinely quantify the surrogate error, therefore it is chosen as metamodeling technique. Enhanced version of ideal gas molecular movement (EIGMM) algorithm is used as main algorithm for model updating. The developed approach is applied to detect simulated damage in numerical models of 72-bar space truss and 120-bar dome truss. The simulation results show the proposed method can perform well in probability-based damage detection of structures with less computational effort compared to direct finite element model.

Keywords : probability-based damage detection (PBDD), Kriging, surrogate modeling, uncertainty quantification, artificial intelligence, enhanced ideal gas molecular movement (EIGMM)
Conference Title : ICSRD 2020 : International Conference on Scientific Research and Development
Conference Location : Chicago, United States
Conference Dates : December 12-13, 2020