Surrogate Optimisation for enhancing the performance of nonlinear dynamical systems

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Surrogate models are mathematical tools that can swiftly generate representations of computationally expensive simulations or systems. Surrogate optimisation (SO) algorithms leverage the benefits of surrogate models in combination with optimisation techniques to solve optimisation problems while significantly reducing the number of evaluations of cost functions. In vibration mitigation and energy harvesting problems, the objective functions are often represented by complex nonlinear multidimensional models, making classical optimisation algorithms ineffective and computationally costly, thereby paving the path for surrogate optimisation. The SO approach facilitates the identification of optimal design parameters for a nonlinear system of interest, even when the system is subjected to a stochastic excitation and a cost function exhibits multiple local minima. In this presentation, the versatility of the SO is demonstrated by considering three different systems: tuning deterministic Nonlinear Energy Sink; optimising the performance of a Triboelectric Energy Harvester; enhancing the efficiency of the stochastic Targeted Energy Transfer.