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MULTIDISCIPLINARY/MULTIOBJECTIVE DESIGN OPTIMIZATION OF STRUCTURES BY MEANS OF A NOVEL DYNAMIC PARTICLE SWARM

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ABSTRACT

In modern structural design, optimum methods play an increasingly important role. Most real-world design optimization problems in structures are multimodal and involve the interaction of different disciplines, such as structural performance (minimum cost subjected to constraints on stress, displacement, buckling and period) and dynamic control of their response under the action of seismic loadings. Modern optimization methodologies, i.e. evolutionary computing, outperform traditional methods to obtain compromises designs, which are more realistic due to they are obtained under different loading conditions at the minimum cost.

Among the different evolutionary methodologies, particle swarm optimization (PSO) have shown considerably developments in recent years [1], being inspired on the acting of communities that present both an individual and a social behavior, from which the main socio-cognitive ideas may be applied to the development of efficient algorithms that have been used to solve multi-objective optimization problems. This article presents the use of a dynamic PSO in a multidisciplinary environment, which used a dynamic mutation operator [2] that is able to maintain the necessary diversity in the particles of the swarm.

The proposed method coordinates standard dynamic finite-element structural analysis, multivariable controls, and nonlinear programming codes and allows simultaneous optimization of the structures and dynamic control behaviour of a generic frame structure. A model of a structure is investigated to show the effectiveness of the proposed methodology to deal with its structural design and its dynamical control.

The analysis procedure shows that the MD/MO optimization of a seismic structure [3] which works under the environment of static and dynamic loading is necessary to better utilize design resource and achieve ideal dynamic response at minimal cost.

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