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Particle swarm-based vertebrae spine modelling for steering vibration impact analysis (Conference Paper)

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Abstract

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Vibrations due to steering motions always gave direct vertical impact towards human vertebrae spine. A lot of studies are carried by various researchers in this field, evaluating the injury risks to vertebrae when it exposed to vertical vibration. One of the major risks associated is low back pain which accounts to major economic loss in terms of direct and indirect costs. Therefore, an accurate vertebrae modelling is of prime important for vibration suppression analysis. The white-box model of the vertebrae is obtained using Rayleigh beam element, which account for bending and rotary inertia. Followed by the muscle strength and the inter-vertebrae fluid are represented by a spring damper system. The objective of this paper is to apply a grey-box modelling approach to model the dynamic behaviour of human vertebrae. The conjecture is that the white-box model will retain what is known about the physical behaviour of the vertebrae using mathematical modelling. The black-box modelling using particle swarm optimisation (PSO) will then used the input and output information from the white-box model to obtain an accurate transfer function parameters. In order to increase robustness to the model, effects of phenomena that are not modelled in the white-box model such as vehicle speed variation is included. The grey-box model is therefore yield an accurate model of the human vertebrae which is suitable for further investigation using active vibration suppression control. Correlation tests are carried out to determine the effectiveness of the modelling technique. It is evidence that the model complies with all the five correlation tests, indicating that the model behaviour is unbiased. © Springer International Publishing Switzerland 2014.

Author keywords

Grey-box modelling Human verterbrae model Particle swarm optimisation Rayleigh beam element Steering vibration White-box model

Indexed keywords

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