15th INTERNATIONAL CONFERENCE
Dynamical Systems — Theory and Applications
December 2-5, 2019. Lodz, POLAND.

DSTA 2019

paper id: MAT163

Fractional nonlinear viscoelastic rubbers for base isolated systems

Andrea Burlon, Mario Di Paola, Giuseppe Failla

Abstract: Base isolation is often used to prevent structural damage from earthquake shaking and, among different isolation devices, friction-pendulum and viscoelastic-rubber devices are certainly most common. For structural dynamic analyses, an accurate modelling of the base isolation device is obviously crucial and, specifically, a rigorous description of the actual constitutive law is of outmost importance for viscoelastic rubbers. The paper will address this issue starting from the observation that the rubber creep law is indeed a power law in time, with a coefficient depending non-linearly on the stress. This implies that the stress-strain constitutive law is inherently non-linear and, as a result, the Boltzmann superposition principle does not apply. To overcome this limitation, the paper will propose a non-linear variable transformation to a new space where the classical linear stress-strain relation, involving standard fractional operators, is obtained. Dynamic analyses of a single-degree-of-freedom structural system, base-isolated by a viscoelastic-rubber device, will be presented in both frequency and time domains by using artificial earthquake time histories. The purpose is to show how the amount of dissipated energy and reduction in the maximum response amplitude change whereas the proposed, accurate model is used for the viscoelastic-rubber device.

[1)] Andrea Burlon, Ph.D.: Mediterranea University of Reggio Calabria, Via Graziella-Feo di Vito 89124 Reggio Calabria, Italy (IT), a.burlon91@gmail.com , the author presented this contribution at the conference in the special session: "Innovative strategies for vibration control and mitigation" organized by G. Failla and R. Santoro.

[2)] Mario Di Paola, Professor: University of Palermo, Viale delle Scienze 90128, Italy (IT), mario.dipaola@unipa.it .

[3)] Giuseppe Failla, Associate Professor: Mediterranea University of Reggio Calabria, Via Graziella-Feo di Vito 89124 Reggio Calabria, Italy (IT), giuseppe.failla@unirc.it .