Computerized selector system of spectral-compatibility ground motions by equalizing energy permitting reliability and likelihood control too

KEYWORDS

- ❑ EARTHQUAKE
- ❑ EARTHQUAKE-BUILDING PROTECTION
- ❑ SEISMIC RISK MITIGATION
- ❑ NATIONAL CIVIL PROTECTION

AREA

- ❑ CIVIL, CONSTRUCTION & MECHANICAL ENGINEERING

CONTACTS

➢ PHONE NUMBERS
+39.06.49910888
+39.06.49910855

➢ EMAIL
u_brevetti@uniroma1.it

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Patent Type
Patent for invention

Co-Ownership
Sapienza University of Rome 90%, University of Firenze 10%.

Inventors
Grelle Gerardo, Sappa Giuseppe, Madiai Claudia

Industrial & Commercial Reference
Building and Infrastructures, Territorial planning, risk management, and civil protection, home insurance.

Time to Market
Full development with continuous updates. The market will define by the interaction between the Universities and the Bodies acting on seismic risk management and mitigation.

Availability
Research, development, experimentation and collaboration

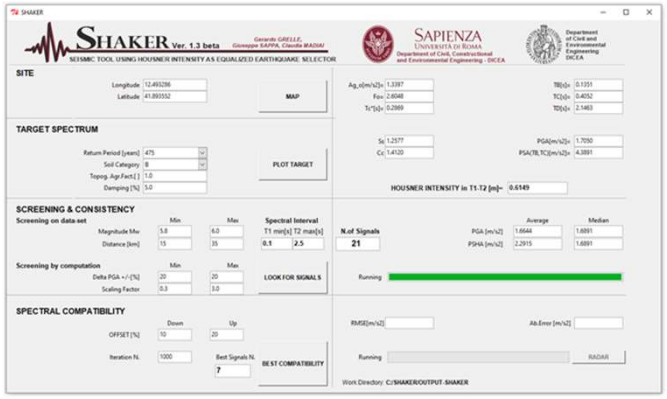

Fig. 1 Graphic User Interface of the computerized system

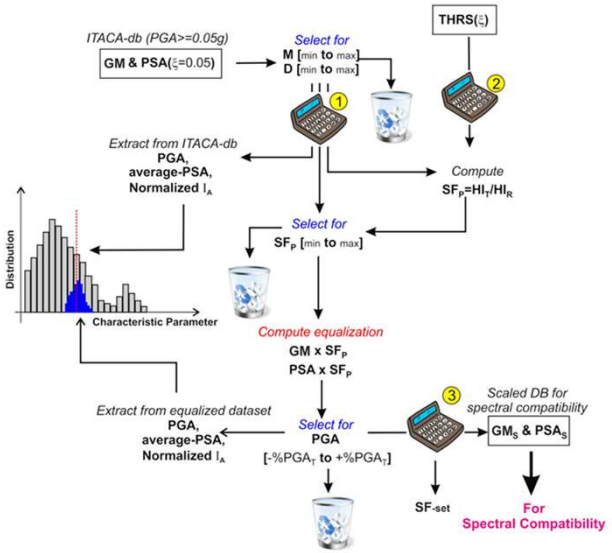

Fig. 2 Flow chart of the ground motions preselection with associated multi-parametric consistency analysis

Abstract
Due to the aleatory nature of the seismic shaking, the spectral compatibility, requirement to satisfy the technical regulation alone, appears very weak to guarantee adequate seismic inputs to represent the local seismic hazard. Magnitude-Distance range pairs to control selection, and scale factor thresholds, do not always provide seismic inputs with suitable energy levels. To address these challenges, this computer-aided selection system relies on consistency analysis to provide seismic inputs with realistically reliable spectral energy distributions.
With this aim, a multi-parameter consistency analysis based on statistical confidence is performed on the energetically equalized seismic input set.

Computerized selector system of spectral-compatibility ground motions by equalizing energy and permitting a reliability and likelihood control

Technical Description

The proposed system, encoded in a computer code tool named SHAKER (Seismic Housner intensity As earthquaKE selectoR), is aimed at the selection of a set of natural accelerograms to match the local hazard response spectrum (spectral compatibility). The scaling is functional to the energetic equalization of the signals in terms of Housner Intensity, and a double level of preselection is carried out on the seismological and seismic parameters. In the pre-selection phase, a statistical consistency analysis of the scaled ground movements is performed based on multi-parameter confidence levels compared to the real ground movements contained in the database.

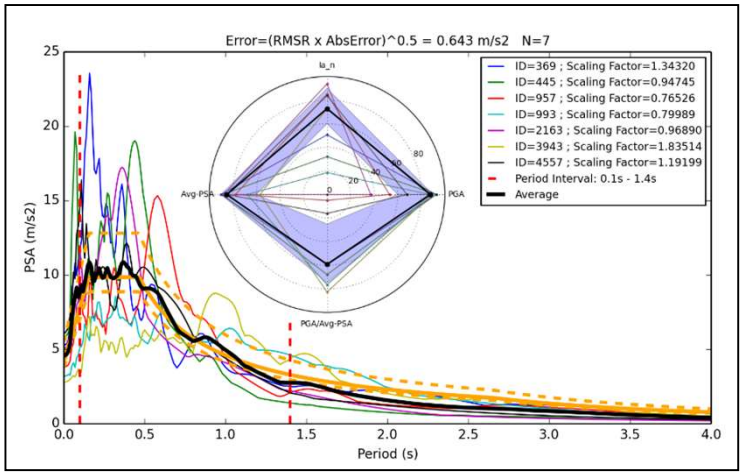

Fig. 3 Spectral-compatibility ground motions with equalized energy with the associated consistency analysis shown by the radar diagram

Technologies & Advantages

An innovative computer selector system is proposed based on a different approach than traditional systems. This has been developed to minimize possible energy and spectral shape inconsistencies in ground motion sets from spectra-compatibility processes. The system provides ground motion sets by using an input multiparametric selection criterion, driven in progress, to reach the multiparametric consistency of the outputs. In addition, scaling by conserving the spectral target energy allows for excluding largely predominant or minority waveforms from the selection; these are usually inserted only as mathematical solutions for compatibility. Therefore, ground motion sets achieving appropriate consistency levels, adequate equivalent energy levels, and spectral assortment are the priority targets over the spectral compatibility process.

In this way, the proposed system also presents greater and more rigorous scientific value, in addition to fulfilling requirements from regulations.

Applications

SHAKER is a tool applicable in all the areas of civil and environmental engineering for which the definition of an appropriate seismic action is required. These areas include: the design of new engineering works, the verification of existing works, and the design of seismic improvement or adaptation interventions. Many types of engineering works are involved: civil and industrial buildings, historical and monumental buildings, tunnels, bridges, viaducts, lifeline systems, road and railway embankments, river and dam embankments. As well as landslides and soil liquefaction/compactions effects.

Further application fields concern: the estimation of the seismic risk of buildings for insurance purposes, the stability analysis and the reduction of the seismic risk on a territorial scale, aimed at urban planning and the management of both territory and post-seismic emergency.

CONTACTS

- PHONE NUMBERS
+39.06.49910888
+39.06.49910855

- EMAIL
u_brevetti@uniroma1.it

SAPIENZA UNIVERSITÀ DI ROMA

ARTEM - AREA TERZA MISSIONE E TRASFERIMENTO TECNOLOGICO
UFFICIO VALORIZZAZIONE E TRASFERIMENTO TECNOLOGICO
SETTORE BREVETTI E TRASFERIMENTO TECNOLOGICO
- http://uniroma1.it/ricerca/brevetti