

REXELite, internet-based record selection on ITACA

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INTRODUCTION

REXELite is an internet version, operating on the Italian ACcelerometric Archive (ITACA, <http://itaca.mi.ingv.it>), of REXEL [3], a software developed for automatic selection of ground motion suites for code-based structural analysis, and freely available at the website of Rete dei Laboratori Universitari di Ingegneria Sismica (ReLUIS, <http://www.reluis.it>) project. REXELite allows to search for combinations of seven 1- or 2-components strong motion records, compatible on average with a specified target spectrum. More specifically, REXELite: (a) automatically builds code spectra for any limit state according to Eurocode 8 (EC8) [1] and the new Italian building code spectra (NIBC) [2]; (b) finds the set of seven ITACA records having the most similar spectral shape with respect to that of the code, and whose average also matches the target spectrum in a user-specified period range and with the desired tolerance. The records are selected according to specific features, in terms of magnitude, distance and soil conditions, selected by the user. The set of accelerograms of the combination may include unscaled (original) or amplitude-scaled records [3] and may be used for code-compliant non-linear time history analyses of structures. REXELite was developed, in cooperation with ReLUIS, within the INGV-DPC S4 project (<http://esse4.mi.ingv.it>).

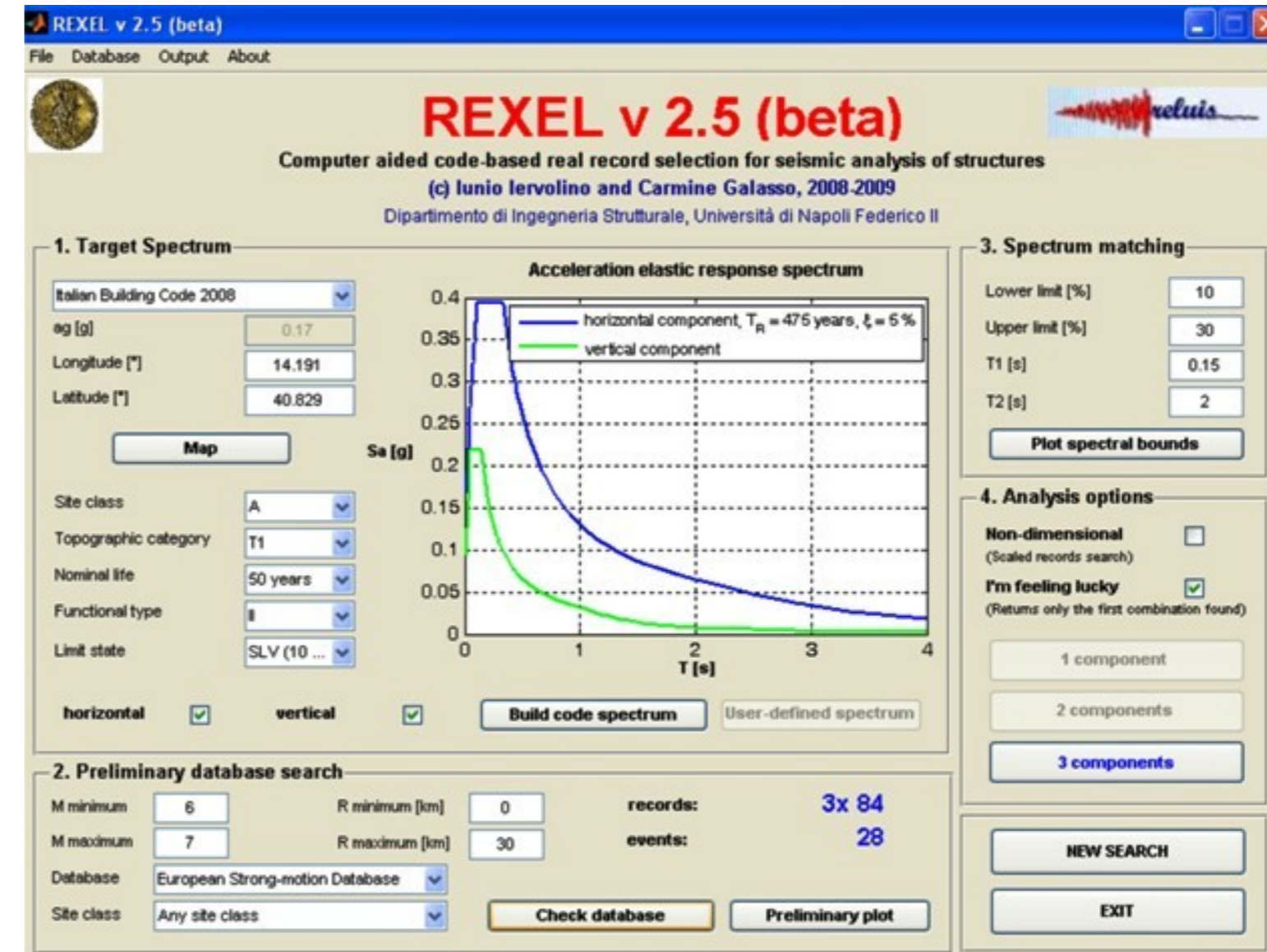


Image of the REXEL (v 2.5 beta) GUI - <http://www.reluis.it/>

REXELITE

The procedure implemented in REXELite for record selection deploys in four basic steps:



The entered coordinates are plotted on map when the users accepts input parameters...

1 Target Spectrum

Definition of the design horizontal or vertical spectra the set of records has to match on average according to EC8 or NIBC.

Target spectrum

Latitude [degrees] 45.48 Longitude 9.23

Site classification (EC8) A

Topography T1 - flat surfaces, isolated cliffs and slopes with average slope angle not greater than 15°

Nominal life [years] 50 years - ordinary structures

Building functional type 2 - ordinary structures (Cu=1.0)

Limit state probability Life safety (P=10%)

Ground motion components One horizontal component

Parameters required by the NIBC to define the return period of the seismic action.

2 Preliminary search

Choosing to search for combination coming from specific magnitude and epicentral distance ranges (this choice may be driven by disaggregation of seismic hazard). It is possible to select records from any site class for a given target spectrum or records belonging to the same site class as target spectrum.

Preliminary record search

Station site classification Same site class as target spectrum

Magnitude (M) min 5.5 max 6.5

Epicentral distance [km] min 0 max 50

Include late trigger events Yes

Include analog Yes

Design earthquake (source) parameters

3 Analysis options

Definition of the period range where the average spectrum of the set has to be compatible with the target spectrum and specification of tolerances in compatibility.

Spectrum matching parameters and analysis options

Period range [s] from 0.15 to 2

Tolerance [%] from 10 to 30

Non-dimensional

REXELite also allows to obtain combinations of records compatible with the target spectrum if scaled linearly.

Image of the REXELite GUI - <http://itaca.mi.ingv.it/>

... and 4 Run REXELite ...

REXELITE RESULTS

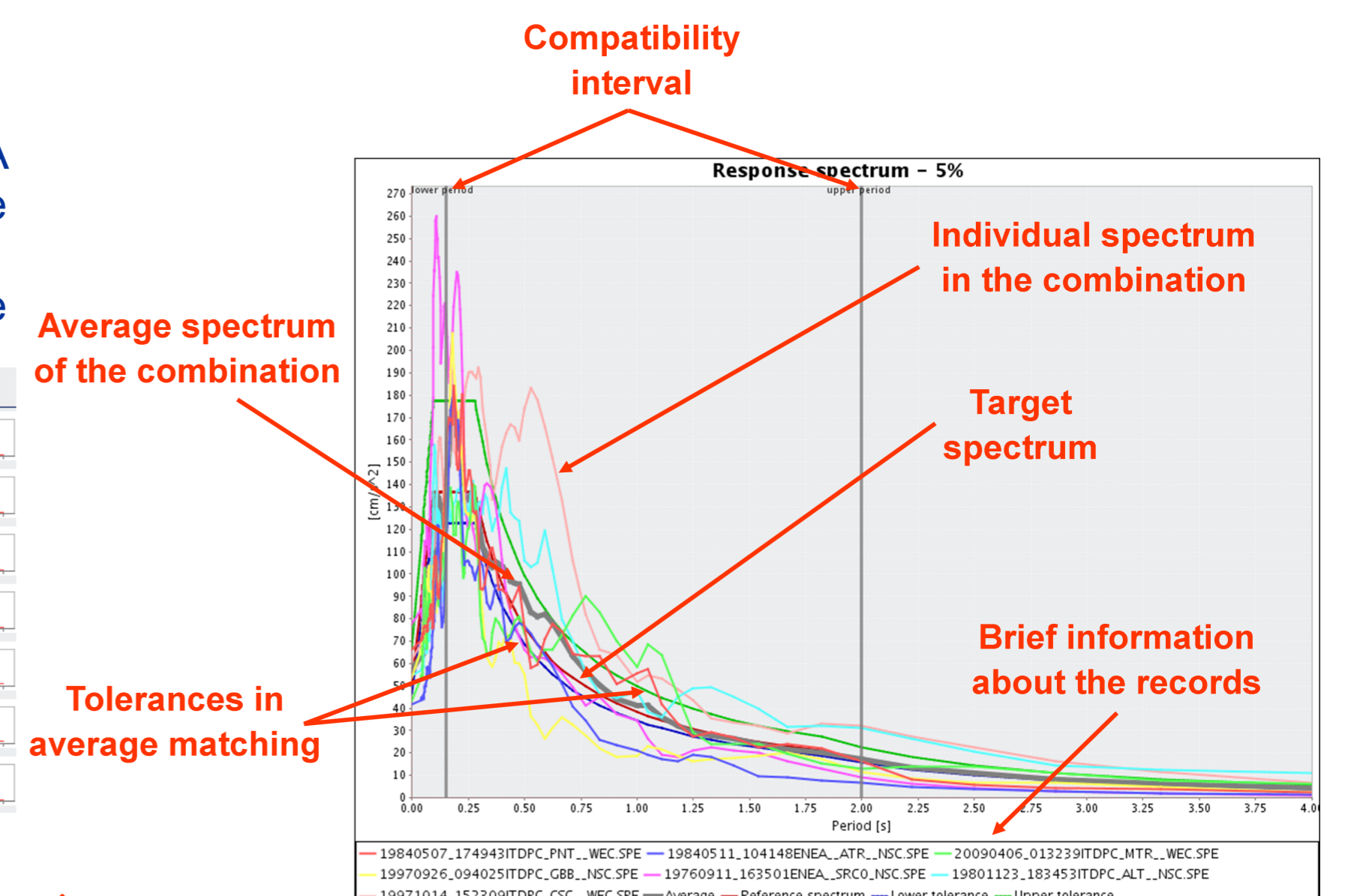
The software analyzes all the possible combinations of seven spectra that can be built from records found in ITACA (for the ranges of magnitude and distance chosen) and checks whether each combination is compatible, in average sense and with the assigned tolerances, with the code spectrum.

The analysis is stopped after the first compatible combination is found. An important feature of the code is that the list of records out of step 2 (Preliminary search) are ordered when the analysis is launched according to a measure accounting for the deviation of individual spectrum from the target spectrum. This ensures the combination found to be those with the smallest individual scattering in respect to the target spectrum. Large individual variability may affect the accuracy of the estimation of the structural performance if a limited number of records (e.g., 7 according to the codes) is employed [3].

REXELite returns records and spectra of the combination found grouped in a compressed file and the information about the individual waveforms as retrieved by ITACA.

Network	Station code	Type	Event time	Scale factor	Usable Bandwidth	Orientation	Waveform	Sparkline
ENEA	SBCO	Analog	1978-09-11 16:35:04	1.0	28.8	NS		
ITDPC	ALT	Analog	1980-11-23 18:34:53	1.0	29.85	NS		
ITDPC	PNT	Analog	1984-05-07 17:49:53	1.0	28.7	WE		
ENEA	ATB	Analog	1984-05-11 10:41:58	1.0	12.8	NS		
ITDPC	SBB	Analog	1997-09-26 09:40:25	1.0	20.6	NS		
ITDPC	CSC	Analog	1997-10-14 15:23:09	1.0	19.8	WE		
ITDPC	MTB	Digital	2009-04-06 01:32:39	1.0	49.92	WE		

Essential record data returned by REXELite for the combination found



REXELite automatically displays the combination found and spectrum matching parameters specified at step 3

REFERENCES

1. CEN, European Committee for Standardisation (2003). Eurocode 8: design provisions for earthquake resistance of structures, Part 1.1: general rules, seismic actions and rules for buildings, prEN 1998-1
2. CS.LL.PP. (2008). DM 14 Gennaio, Norme tecniche per le costruzioni, Gazzetta Ufficiale della Repubblica Italiana 29 (in Italian)
3. Iervolino I., Galasso C., Cosenza E. (2009). REXEL: computer aided record selection for code-based seismic structural analysis. *Bulletin of Earthquake Engineering*. DOI : 10.1007/s10518-009-9146-1