DESIGN GROUND MOTION LIBRARY (DGML)

Tool for Selecting Time History Records for Specific Engineering Applications

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SMIP07 SEMINAR ON
UTILIZATION OF STRONG-MOTION DATA
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DGML Project Team

Sponsors

- California Geological Survey SMIP
- PEER Lifelines Program

Prime Contractor:

- Geomatrix Consultants

Subcontractors and Consultants:

- Simpson Gumpertz & Heger, Inc. (Ronald Hamburger, Ronald Mayes)
- T.Y. Lin International (Roupen Donikian)
- Quest Structures (Yusof Ghanaat)
- Pacific Engineering & Analysis (Walter Silva)
- URS Corporation (Paul Somerville)
- Earth Mechanics (Ignatius Po Lam)
- Professors Allin Cornell and Jack Baker, Stanford University
- Professor Stephen Mahin, University of California, Berkeley

DGML Basic Objective

- Develop electronic library of ground motion records suitable for time history dynamic analysis of various facility types in California.

  - Records currently limited to recorded ground motion time histories from shallow crustal earthquakes of the type found in California and other parts of the WUS PEER-NGA data set
  - Time histories from subduction zone earthquakes or those simulated by ground motion modeling methods could be added in the future

Evolution of DGML Concept

- Original concept – A “static” library
  - Use appropriate ground motion models to define spectral shapes for “representative” M-R-V_{S30}-Mechanism bins and spectral period ranges
  - Select “good” set of records to represent each bin
- Revised concept – A “dynamic” library
  - Concept of appropriate ground motion spectra evolving
  - User’s specific needs may not match predefined bins and spectral shapes
  - Update library as new recordings become available

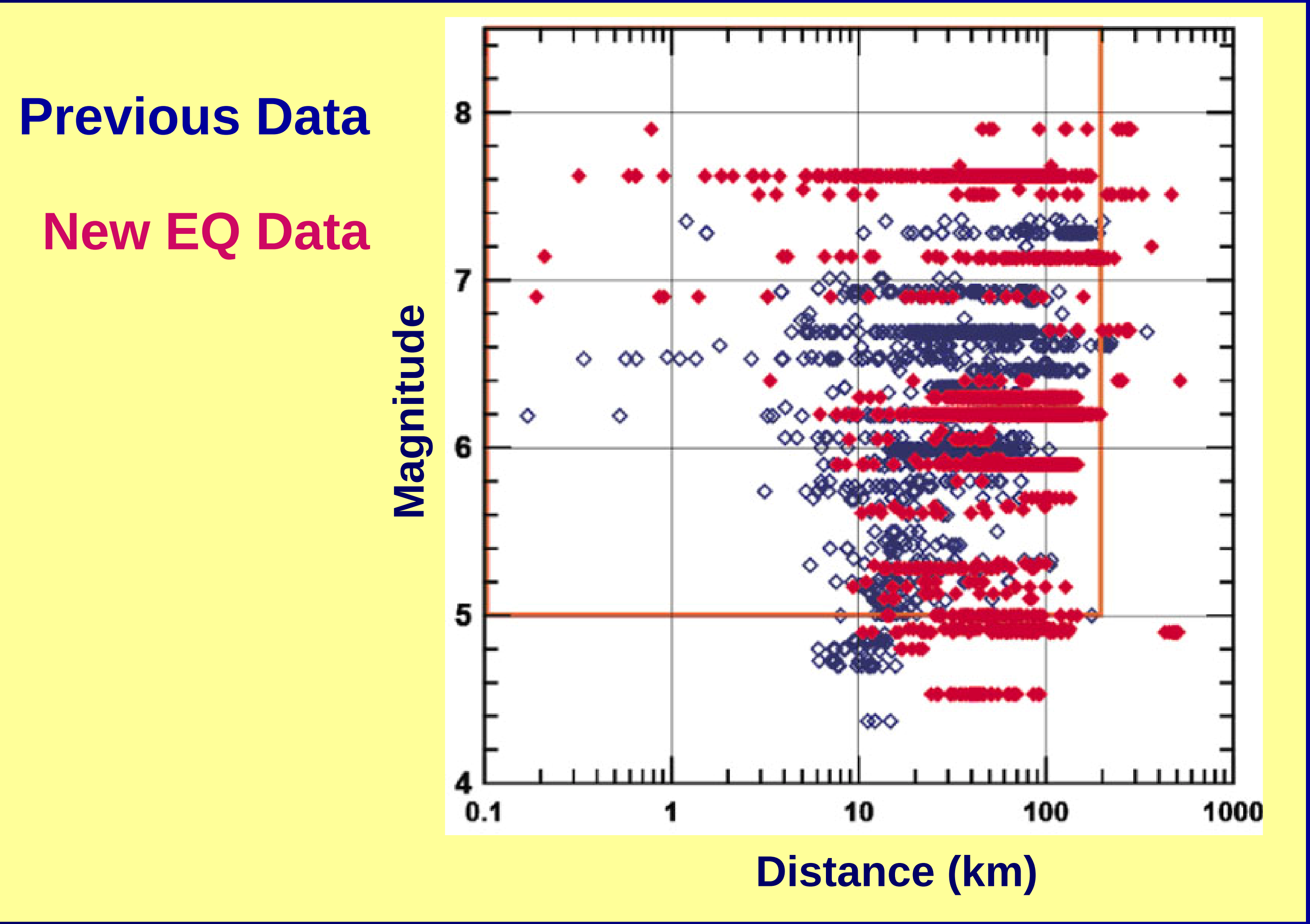
“Dynamic” DGML Objectives

- Develop capability to search for and select time histories using different criteria rather than having fixed data sets (more flexibility for user).
- Take advantage of development of PEER-Next Generation Attenuation (NGA) database.
- Take advantage of recent research conducted primarily by PEER researchers on relationship of inelastic structural response to time history characteristics (e.g. PEER Ground Motion Selection & Modification (GMSM) Working Group, and COSMOS Annual Meeting Technical Sessions).
- Provide method for quickly selecting and evaluating time history data sets and individual time histories for specific applications.

PEER – NGA Data Base

- Comprehensive update of pre-existing PEER data base of ground motion recordings
- Major addition of records (currently 173 earthquakes, 1400 recording stations, and 3500 multi-component recordings).
- Major evaluation, addition, and quantification of supporting information about the records (i.e., metadata):
  - information about the earthquake (e.g. moment magnitude, M; type of faulting; depth to top of fault rupture; rupture directivity parameters).
  - information about source-to-site travel path (e.g. closest distance, R; site location on hanging wall or footwall of reverse or normal fault).
  - local site conditions (e.g. shear wave velocity in upper 30 meters of sediments, VS30; presence and depth of basin).

Magnitude and distance distribution PEER-NGA database.



Basic Features and Capabilities of DGML

- DGML consists of PEER (NGA) data base of ground motion records and software tool to enable searches for ground motion records based on certain criteria and user-specified inputs.
- Time history data sets may be developed by:
  - Searching for records having response spectral shapes that are closest match to target spectrum shapes (different options are available for defining target)
  - Searching for records with or without pulses
  - Searching for records in specific classes of M-R-V_{S30}
- Searches may be further constrained by:
  - Limiting searches based on ground motion duration
  - Specifying number of records
  - Specifying one- or two-horizontal components for selection
  - Specifying maximum record scaling factor

DGMLStart

Design Ground Motion Libaray

An interactive software to select design ground motion records

CALIFORNIA GEOLOGICAL SURVEY

Sponsored by

California Geological Survey (CGS)

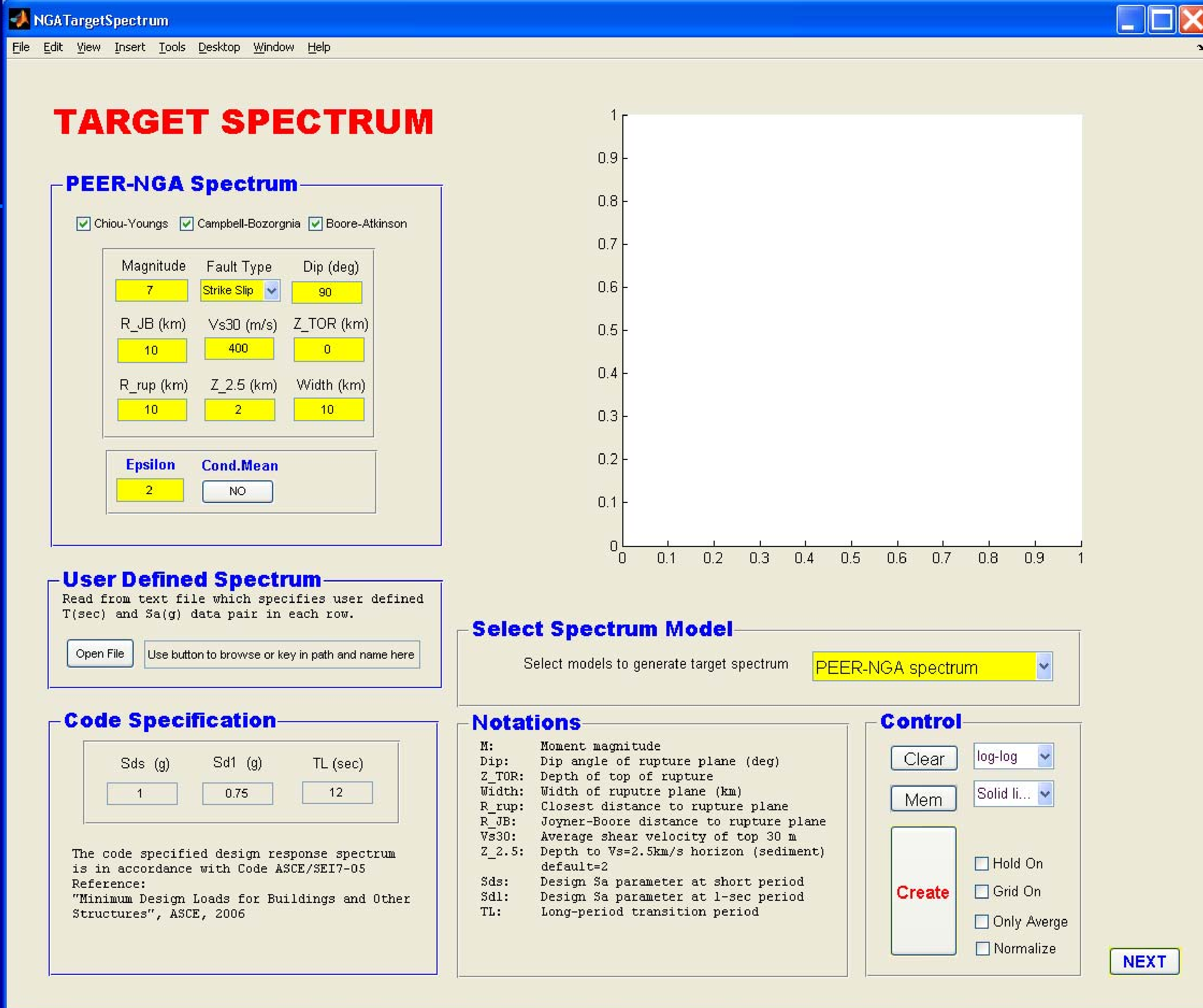
Pacific Earthquake Engineering Research Center (PEER)

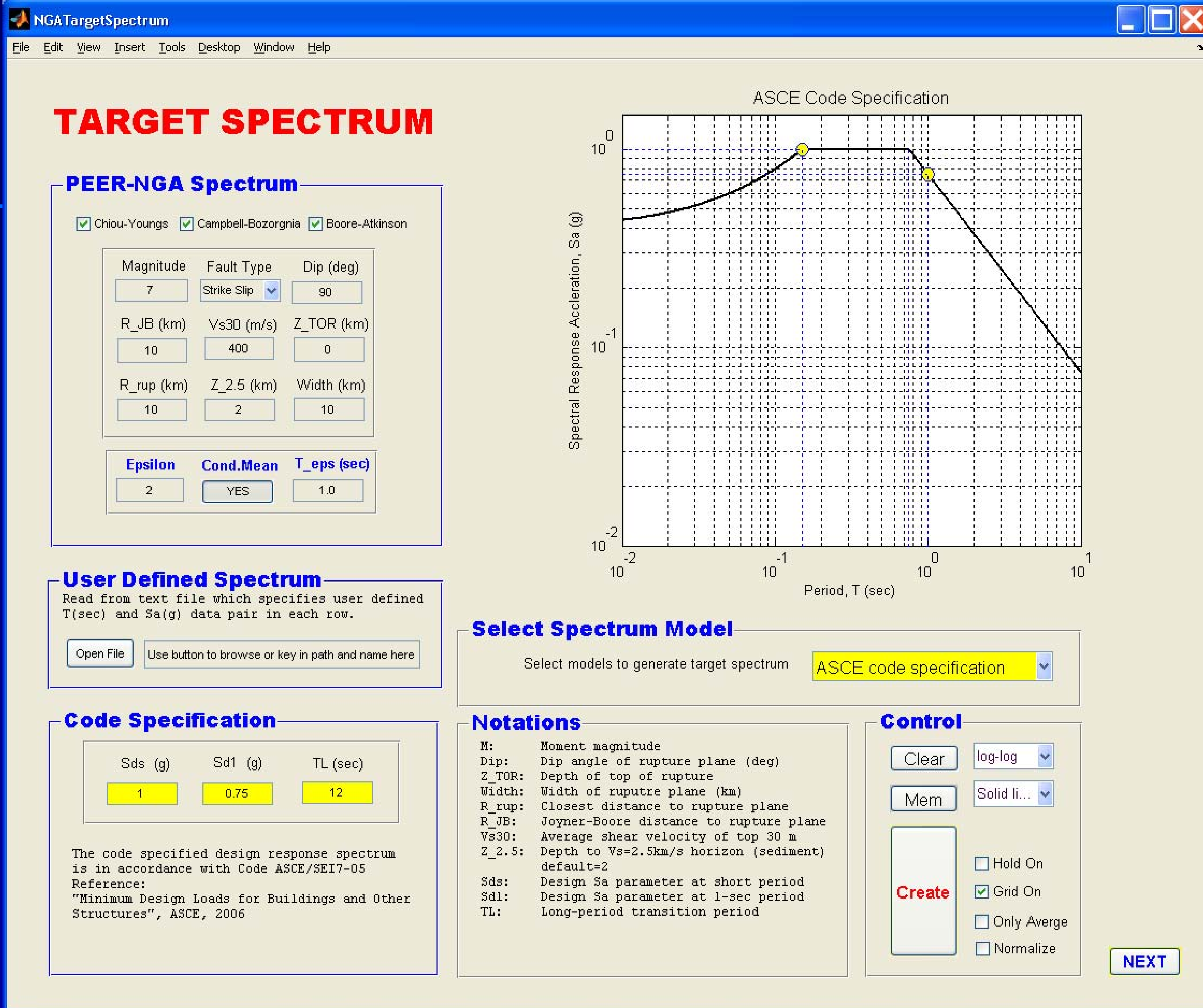
PACIFIC EARTHQUAKE ENGINEERING RESEARCH

START

Step 1: User specifies type of target spectrum and software tool calculates and constructs spectrum.

- Code spectrum: User enters three values that define the spectrum.
  - (1) site-class adjusted 0.2 sec spectral acceleration
  - (2) site-class adjusted 1.0 sec spectral acceleration
  - (3) transition period from constant spectral velocity to constant spectral displacement
- User may enter any spectrum as a table of periods and spectral accelerations – e.g. a Uniform Hazard Spectrum.
- PEER – NGA spectrum (i.e. a scenario earthquake spectrum): User enters magnitude, distance, and site parameters; and tool constructs an average spectrum of the selected NGA models
  - Specify a number of standard deviations (epsilon) for all periods (e.g. an 84^{th}-percentile spectrum).
  - Conditional mean spectrum: Tool can construct spectrum using NGA relations and the Baker and Cornell (2006) model.


NGATargetSpectrum
File Edit View Insert Tools Desktop Window Help
TARGET SPECTRUM
PEER-NGA Spectrum
Chiou-Youngs
Campbell-Bozorgnia
Boore-Atkinson
Magnitude
Fault Type
Dip (deg)
7
Strike Slip
90
R_JB (km)
Vs30 (m/s)
Z_TOR (km)
10
400
0
R_rup (km)
Z_2.5 (km)
Width (km)
10
2
10
Epsilon
Cond.Mean
2
NO
User Defined Spectrum
Read from text file which specifies user defined T(sec) and Sa(g) data pair in each row.
Open File
Use button to browse or key in path and name here
Code Specification
Sds (g)
Sd1 (g)
TL (sec)
1
0.75
12
The code specified design response spectrum is in accordance with Code ASCE/SEI7-05
Reference:
"Minimum Design Loads for Buildings and Other Structures", ASCE, 2006
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Select Spectrum Model
Select models to generate target spectrum
PEER-NGA spectrum
Notations
M: Moment magnitude
Dip: Dip angle of rupture plane (deg)
Z_TOR: Depth of top of rupture
Width: Width of ruputre plane (km)
R_rup: Closest distance to rupture plane
R_JB: Joyner-Boore distance to rupture plane
Vs30: Average shear velocity of top 30 m
Z_2.5: Depth to Vs=2.5km/s horizon (sediment) default=2
Sds: Design Sa parameter at short period
Sd1: Design Sa parameter at 1-sec period
TL: Long-period transition period
Control
Clear
log-log
Mem
Solid li...
Create
Hold On
Grid On
Only Averge
Normalize
NEXT


NGATargetSpectrum
File Edit View Insert Tools Desktop Window Help
TARGET SPECTRUM
PEER-NGA Spectrum
Chiou-Youngs
Campbell-Bozorgnia
Boore-Atkinson
Magnitude
7
Fault Type
Strike Slip
Dip (deg)
90
R_JB (km)
10
Vs30 (m/s)
400
Z_TOR (km)
0
R_rup (km)
10
Z_2.5 (km)
2
Width (km)
10
Epsilon
2
Cond.Mean
YES
T_eps (sec)
1.0
User Defined Spectrum
Read from text file which specifies user defined T(sec) and Sa(g) data pair in each row.
Open File
Use button to browse or key in path and name here
Code Specification
Sds (g)
1
Sd1 (g)
0.75
TL (sec)
12
The code specified design response spectrum is in accordance with Code ASCE/SEI7-05
Reference:
"Minimum Design Loads for Buildings and Other Structures", ASCE, 2006
ASCE Code Specification
Spectral Response Accleration, Sa (g)
Period, T (sec)
Select Spectrum Model
Select models to generate target spectrum
ASCE code specification
Notations
M: Moment magnitude
Dip: Dip angle of rupture plane (deg)
Z_TOR: Depth of top of rupture
Width: Width of ruputre plane (km)
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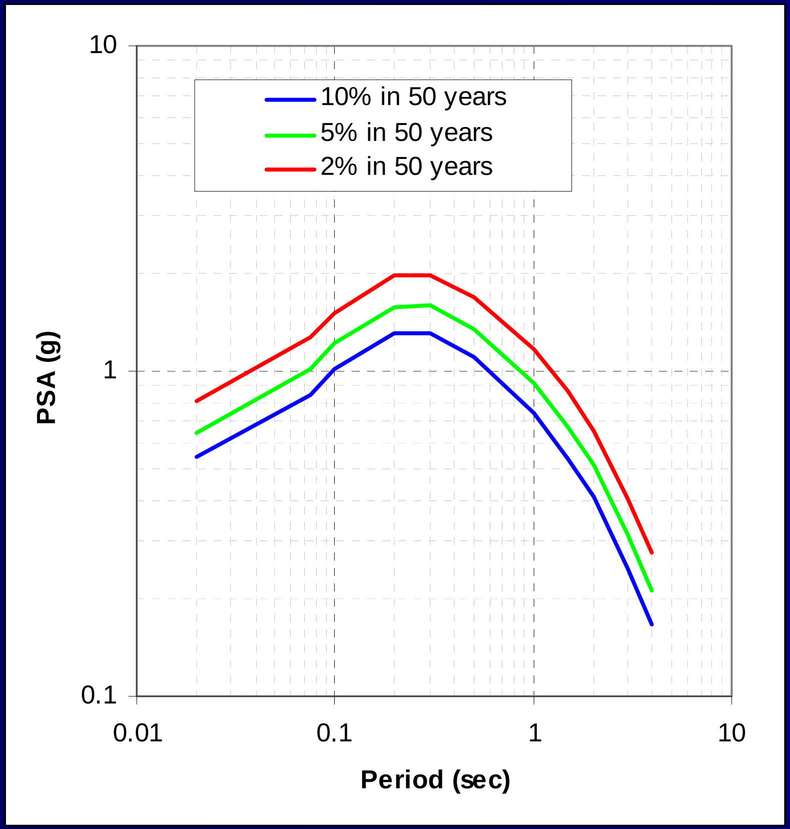
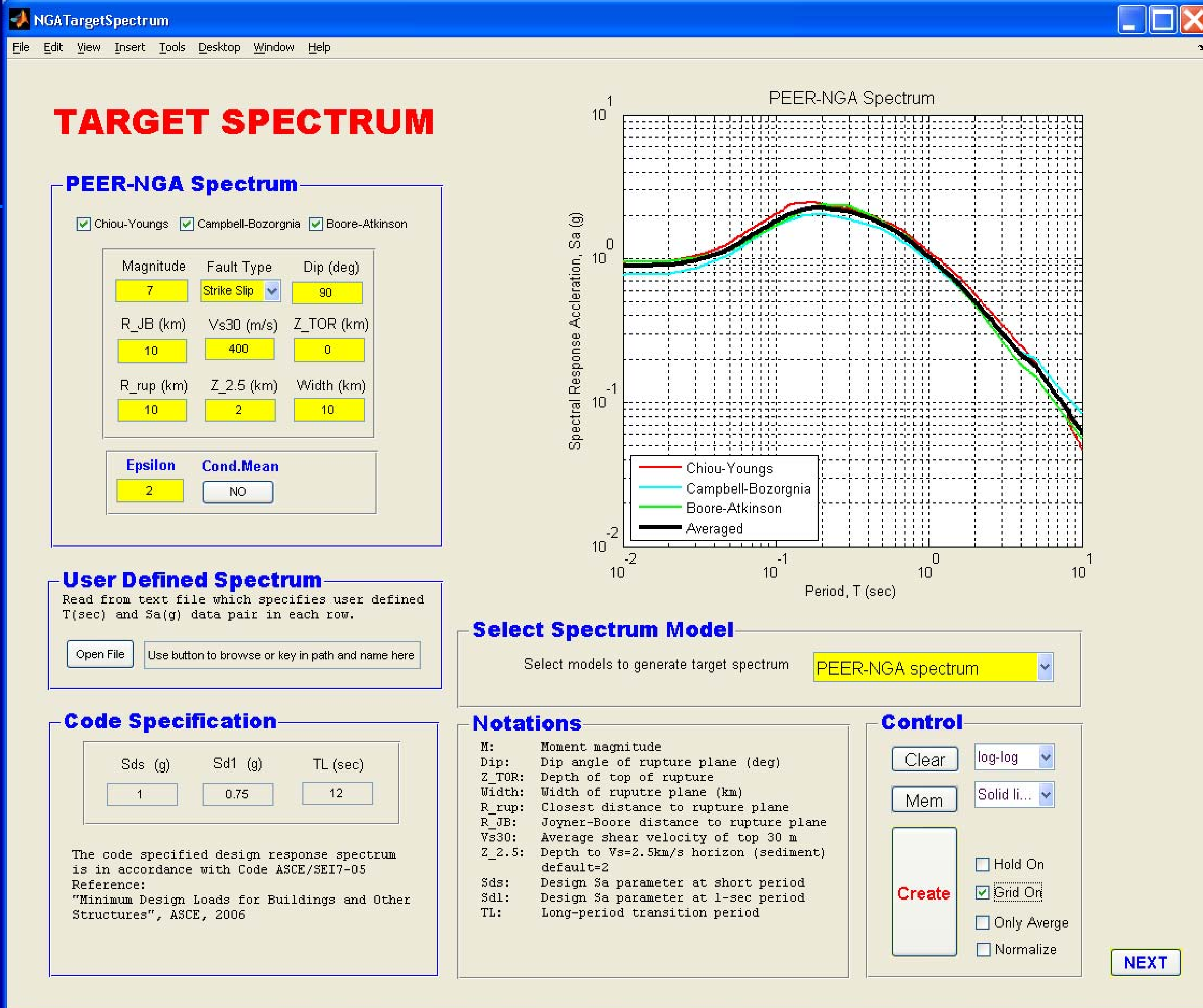
Control
Clear
log-log
Mem
Solid li...
Create
Hold On
Grid On
Only Averge
Normalize
NEXT

User Defined Spectrum



- May be a uniform hazard spectrum from a site-specific PSHA
- May be a deterministic spectrum defined by the user
- Input as a set of periods and spectral accelerations


NGATargetSpectrum
File Edit View Insert Tools Desktop Window Help
TARGET SPECTRUM
PEER-NGA Spectrum
Chiou-Youngs
Campbell-Bozorgnia
Boore-Atkinson
Magnitude
Fault Type
Dip (deg)
7
Strike Slip
90
R_JB (km)
Vs30 (m/s)
Z_TOR (km)
10
400
0
R_rup (km)
Z_2.5 (km)
Width (km)
10
2
10
Epsilon
Cond.Mean
2
NO
User Defined Spectrum
Read from text file which specifies user defined T(sec) and Sa(g) data pair in each row.
Open File
Use button to browse or key in path and name here
Code Specification
Sds (g)
Sd1 (g)
TL (sec)
1
0.75
12
The code specified design response spectrum is in accordance with Code ASCE/SEI7-05
Reference:
"Minimum Design Loads for Buildings and Other Structures", ASCE, 2006
PEER-NGA Spectrum
Spectral Response Accleration, Sa (g)
Period, T (sec)
Chiou-Youngs
Campbell-Bozorgnia
Boore-Atkinson
Averaged
Select Spectrum Model
Select models to generate target spectrum
PEER-NGA spectrum
Notations
M: Moment magnitude
Dip: Dip angle of rupture plane (deg)
Z_TOR: Depth of top of rupture
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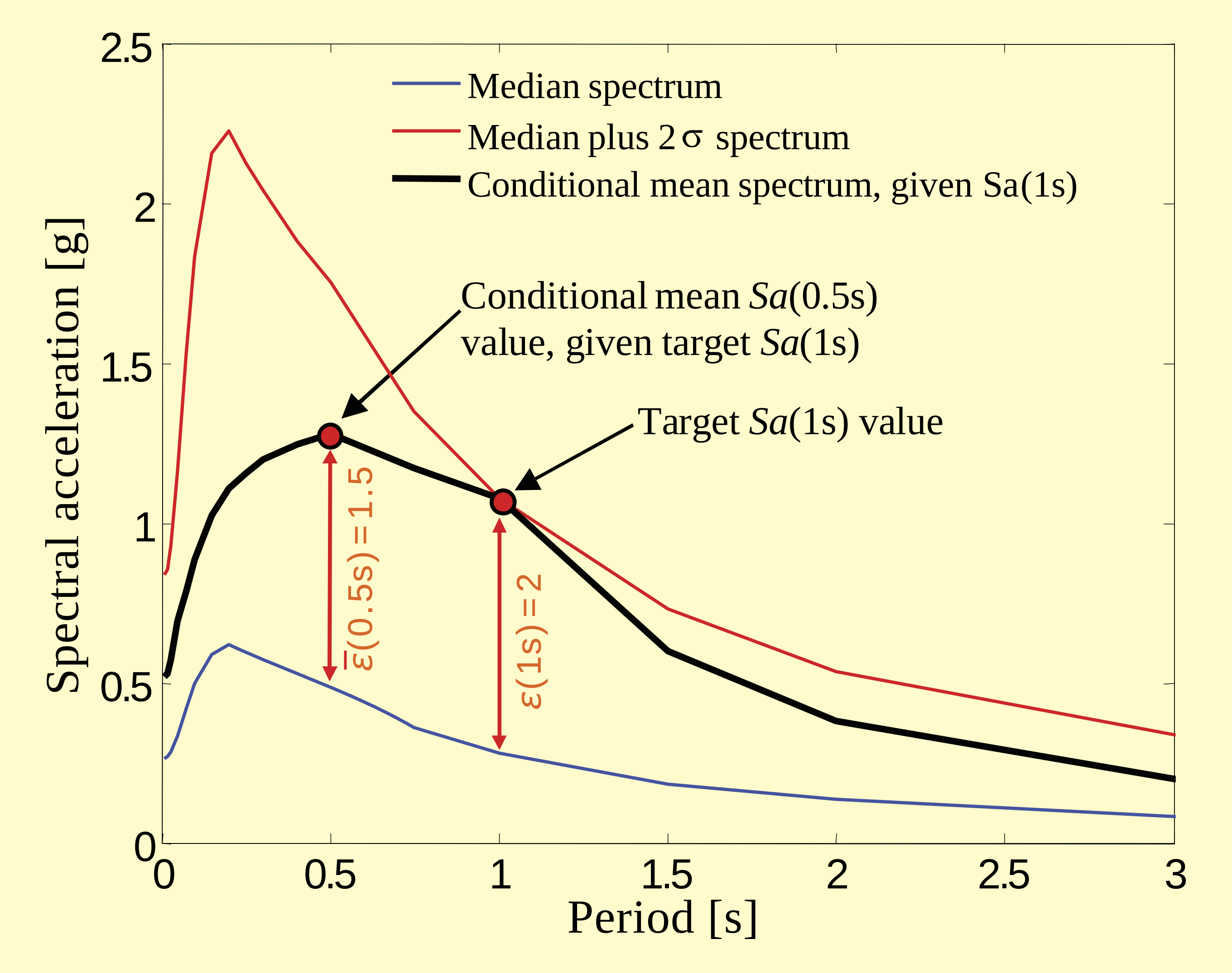
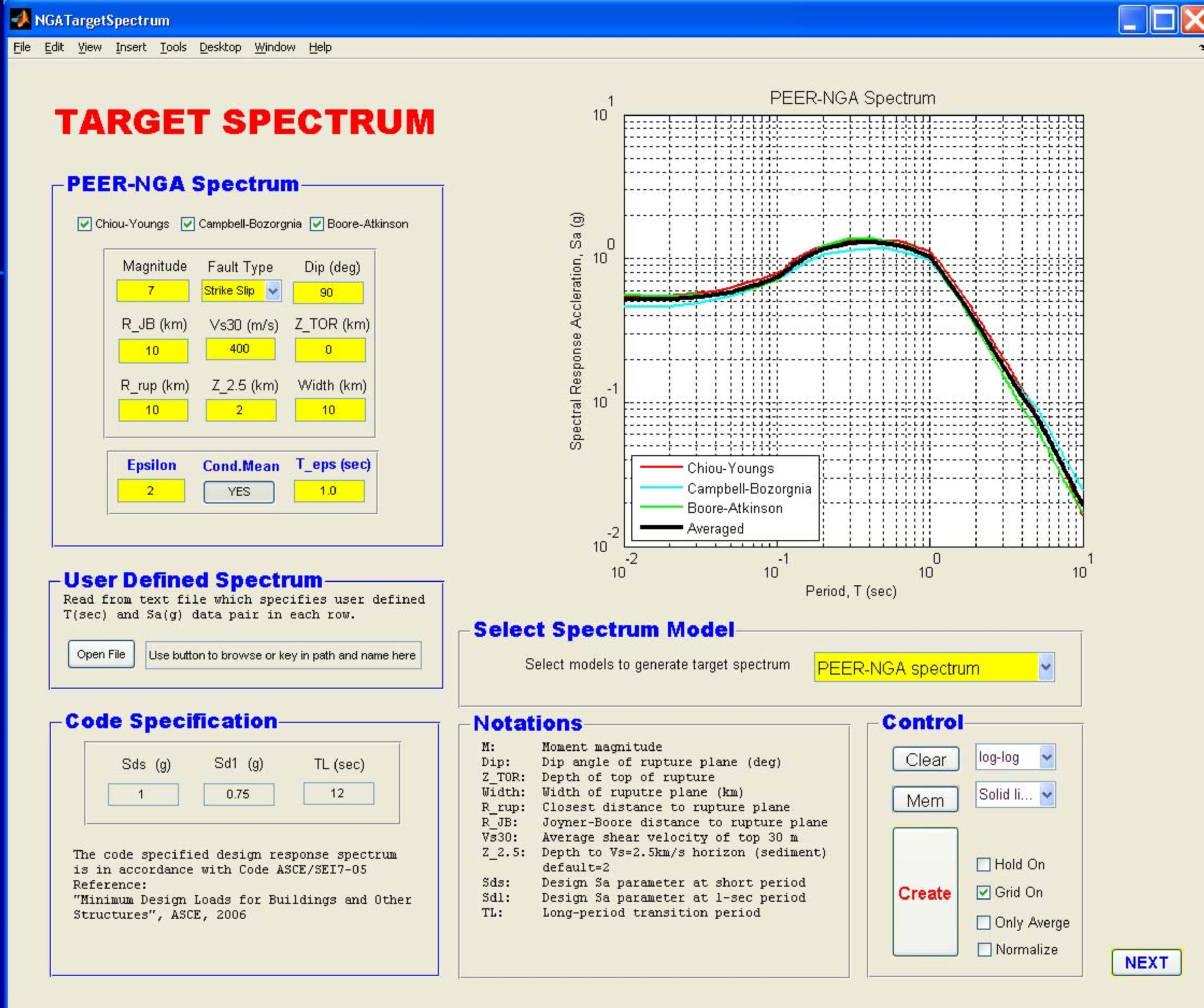
Sds: Design Sa parameter at short period
Sd1: Design Sa parameter at 1-sec period
TL: Long-period transition period
Control
Clear
log-log
Mem
Solid li...
Create
Hold On
Grid On
Only Averge
Normalize
NEXT

The Conditional Mean Spectrum



From: Baker (2006)


NGATargetSpectrum
File Edit View Insert Tools Desktop Window Help
TARGET SPECTRUM
PEER-NGA Spectrum
Chiou-Youngs Campbell-Bozorgnia Boore-Atkinson
Magnitude 7
Fault Type Strike Slip
Dip (deg) 90
R_JB (km) 10
Vs30 (m/s) 400
Z_TOR (km) 0
R_rup (km) 10
Z_2.5 (km) 2
Width (km) 10
Epsilon 2
Cond.Mean YES
T_eps (sec) 1.0
User Defined Spectrum
Read from text file which specifies user defined T(sec) and Sa(g) data pair in each row.
Open File
Use button to browse or key in path and name here
Code Specification
Sds (g) 1
Sd1 (g) 0.75
TL (sec) 12
The code specified design response spectrum is in accordance with Code ASCE/SEI7-05
Reference:
"Minimum Design Loads for Buildings and Other Structures", ASCE, 2006
PEER-NGA Spectrum
Spectral Response Accleration, Sa (g)
Period, T (sec)
Chiou-Youngs
Campbell-Bozorgnia
Boore-Atkinson
Averaged
Select Spectrum Model
Select models to generate target spectrum
PEER-NGA spectrum
Notations
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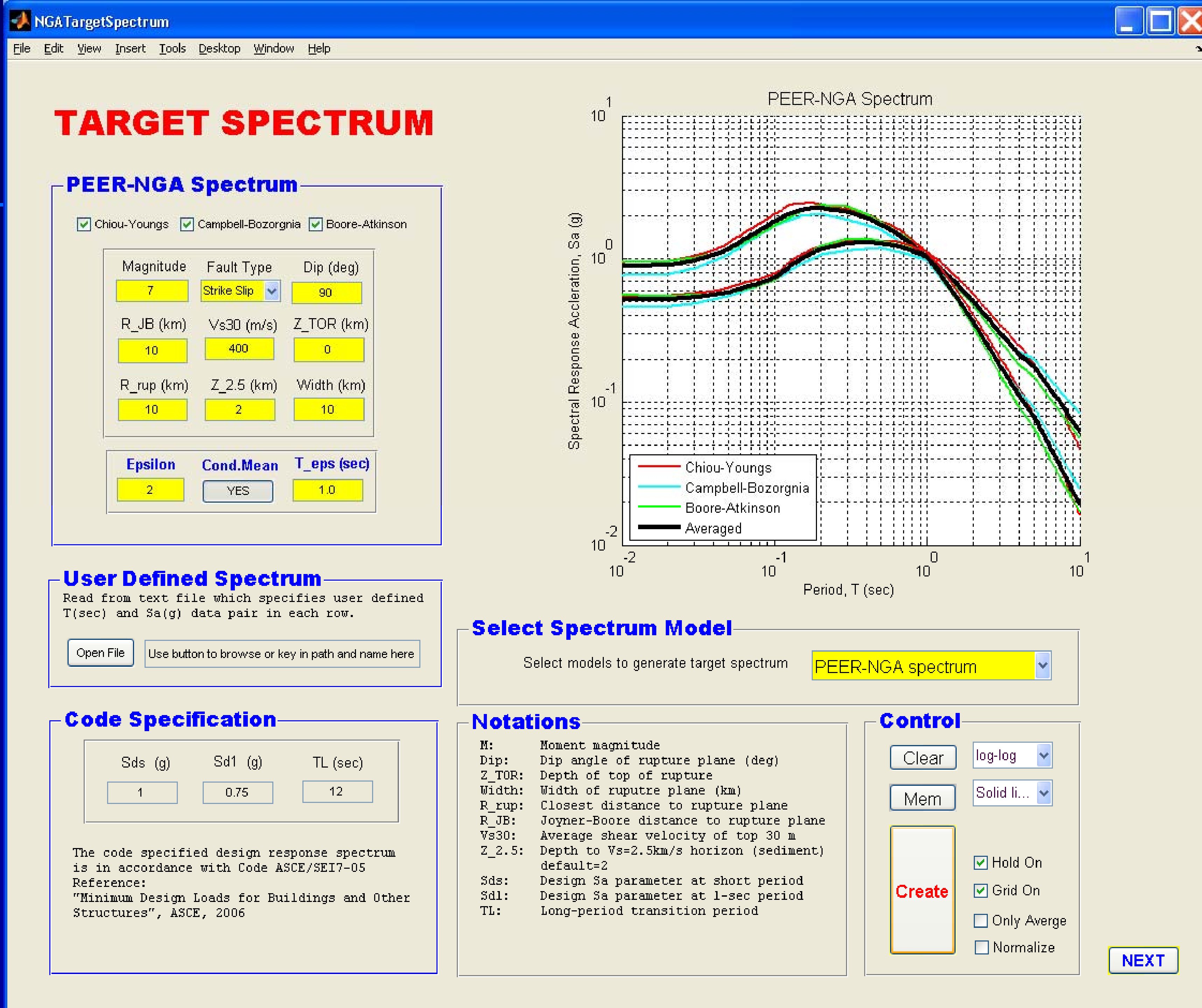
TL: Long-period transition period
Control
Clear
log-log
Mem
Solid li...
Create
Hold On
Grid On
Only Averge
Normalize
NEXT


NGATargetSpectrum
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TARGET SPECTRUM
PEER-NGA Spectrum
Chiou-Youngs
Campbell-Bozorgnia
Boore-Atkinson
Magnitude
Fault Type
Dip (deg)
7
Strike Slip
90
R_JB (km)
Vs30 (m/s)
Z_TOR (km)
10
400
0
R_rup (km)
Z_2.5 (km)
Width (km)
10
2
10
Epsilon
Cond.Mean
T_eps (sec)
2
YES
1.0
User Defined Spectrum
Read from text file which specifies user defined T(sec) and Sa(g) data pair in each row.
Open File
Use button to browse or key in path and name here
Code Specification
Sds (g)
Sd1 (g)
TL (sec)
1
0.75
12
The code specified design response spectrum is in accordance with Code ASCE/SEI7-05
Reference:
"Minimum Design Loads for Buildings and Other Structures", ASCE, 2006
PEER-NGA Spectrum
Spectral Response Accleration, Sa (g)
Period, T (sec)
Chiou-Youngs
Campbell-Bozorgnia
Boore-Atkinson
Averaged
Select Spectrum Model
Select models to generate target spectrum
PEER-NGA spectrum
Notations
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Control
Clear
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Mem
Solid li...
Create
Hold On
Grid On
Only Averge
Normalize
NEXT

Step 2: User Specifies Criteria for Selecting Records

- Basic criteria – spectral shape of recording similar to target
- Period range for matching spectral shape
- Use of individual components (best match of individual spectra); or fault-normal (FN) / fault-parallel (FP) pairs (best match of geometric mean of the two components).
- Number of records (record sets) to for computing average spectra

Define Criteria for Records that "Match Target Spectral Shape"

- Scale spectrum (spectra) to match target spectrum on average (in log space)
- Scaling minimizes mean squared error (MSE) for difference between recording and target
- How well a record matches the target spectral shape is measured by the MSE after scaling
- User has option of not scaling records before computing MSE

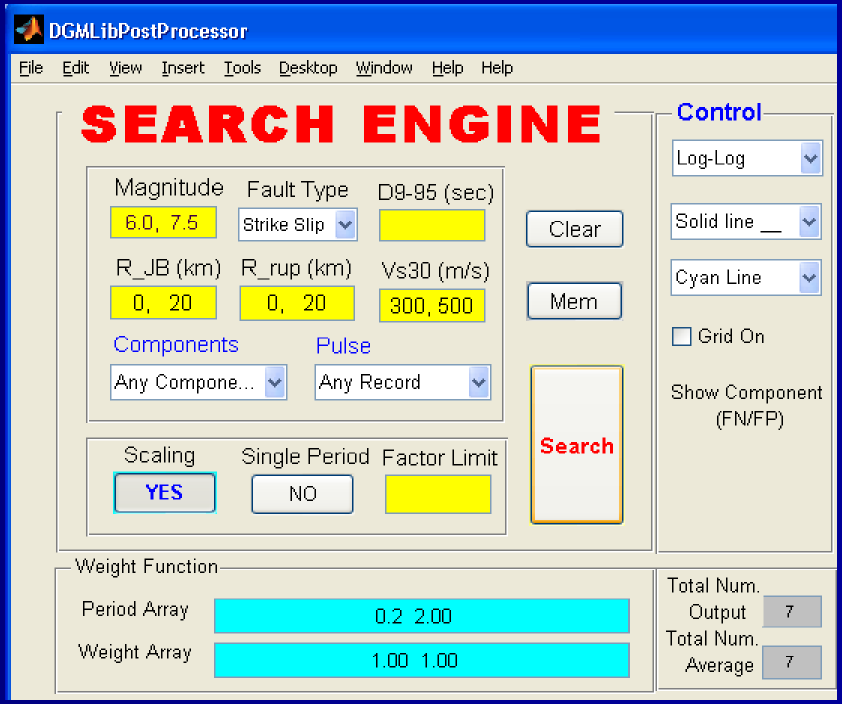
$$\varepsilon(t_i) = \ln\left[SA^{\text{target}}(t_i) \middle/ SA^{\text{recording}}(t_i) \right]$$

$$\bar{\varepsilon} = \sum_i w_i \varepsilon(t_i) \Big/ \sum_i w_i = \ln[\text{scale factor}]$$

$$\text{MSE} = \sum_i w_i \left(\varepsilon(t_i) - \bar{\varepsilon}\right)^2 \Big/ \sum_i w_i$$

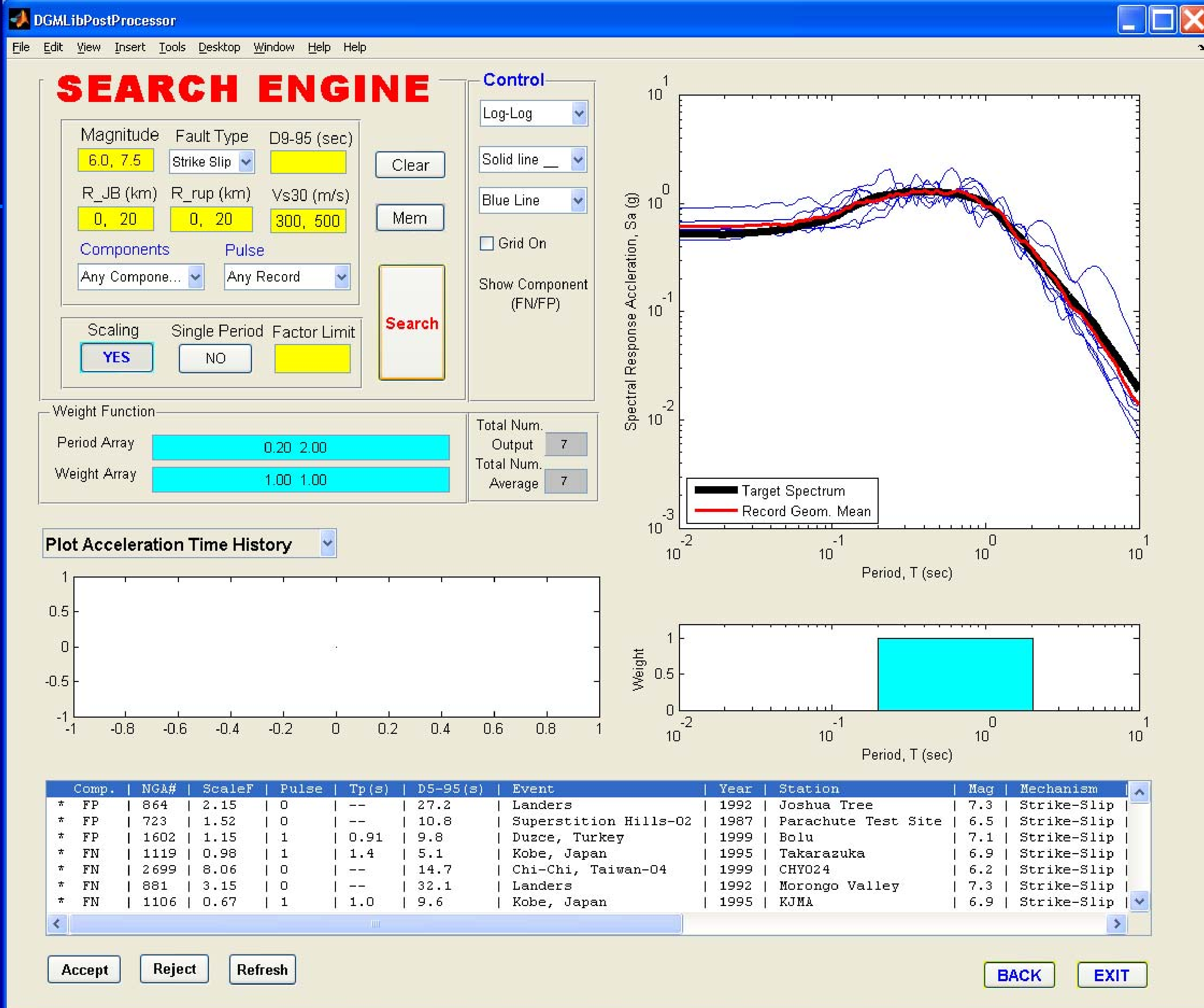
Step 2 (cont'd): User Specifies Limits on Acceptable Records

- Magnitude Range
- Distance Range (R_{RUP}, R_{JB}, or both)
- V_{S30} Range
- Style of faulting
- Significant Duration
- Pulse or no pulse
- Maximum scaling factor



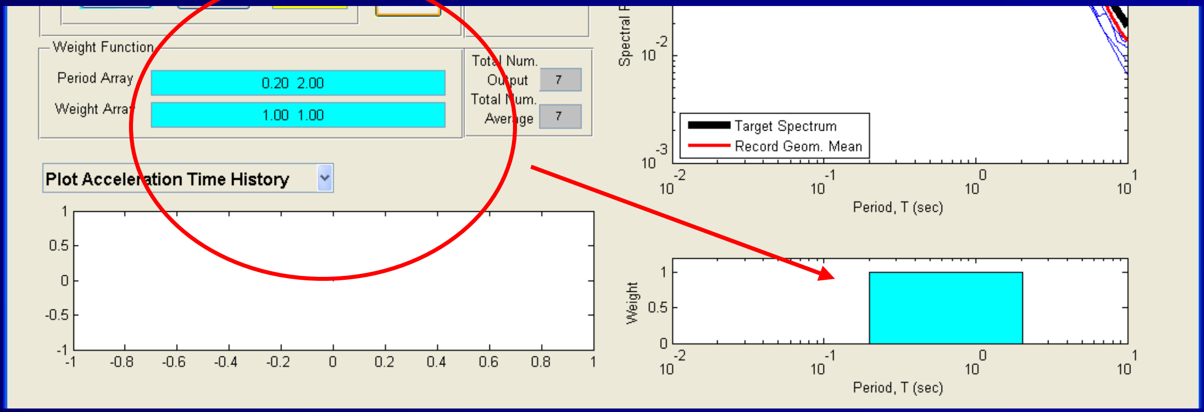
Record Sets for Records with Pulses

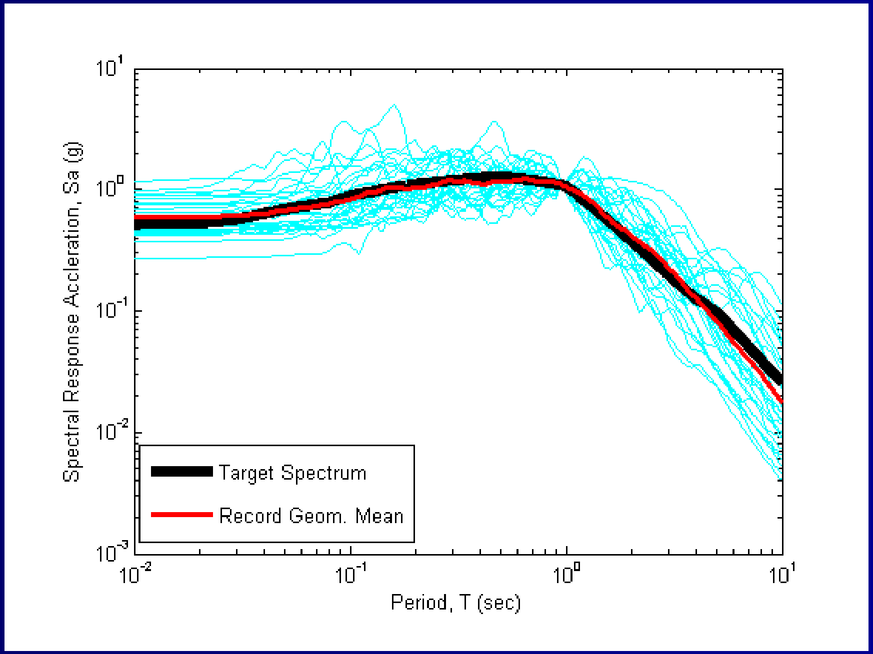
- Data base identifies records with strong velocity pulses based on research by Baker (2007). Pulses are identified on FN and FP components.
- Pulses were identified based on wavelet analysis with following criteria:
  - (1) pulse is large relative to residual features of the record after the pulse is extracted.
  - (2) pulse arrives early in time history as expected for association with rupture directivity effects.
  - (3) pulse has large absolute amplitude (PGV of record $\geq$ 30 cms/sec).



Comp.	NGA#	ScaleF	Pulse	Tp(s)	D5-95(s)	Event	Year	Station	Mag	Mechanism
* FP	864	2.15	0	--	27.2	Landers	1992	Joshua Tree	7.3	Strike-Slip
* FP	723	1.52	0	--	10.8	Superstition Hills-02	1987	Parachute Test Site	6.5	Strike-Slip
* FP	1602	1.15	1	0.91	9.8	Duzce, Turkey	1999	Bolu	7.1	Strike-Slip
* FN	1119	0.98	1	1.4	5.1	Kobe, Japan	1995	Takarazuka	6.9	Strike-Slip
* FN	2699	8.06	0	--	14.7	Chi-Chi, Taiwan-04	1999	CHY024	6.2	Strike-Slip
* FN	881	3.15	0	--	32.1	Landers	1992	Morongo Valley	7.3	Strike-Slip
* FN	1106	0.67	1	1.0	9.6	Kobe, Japan	1995	KJMA	6.9	Strike-Slip

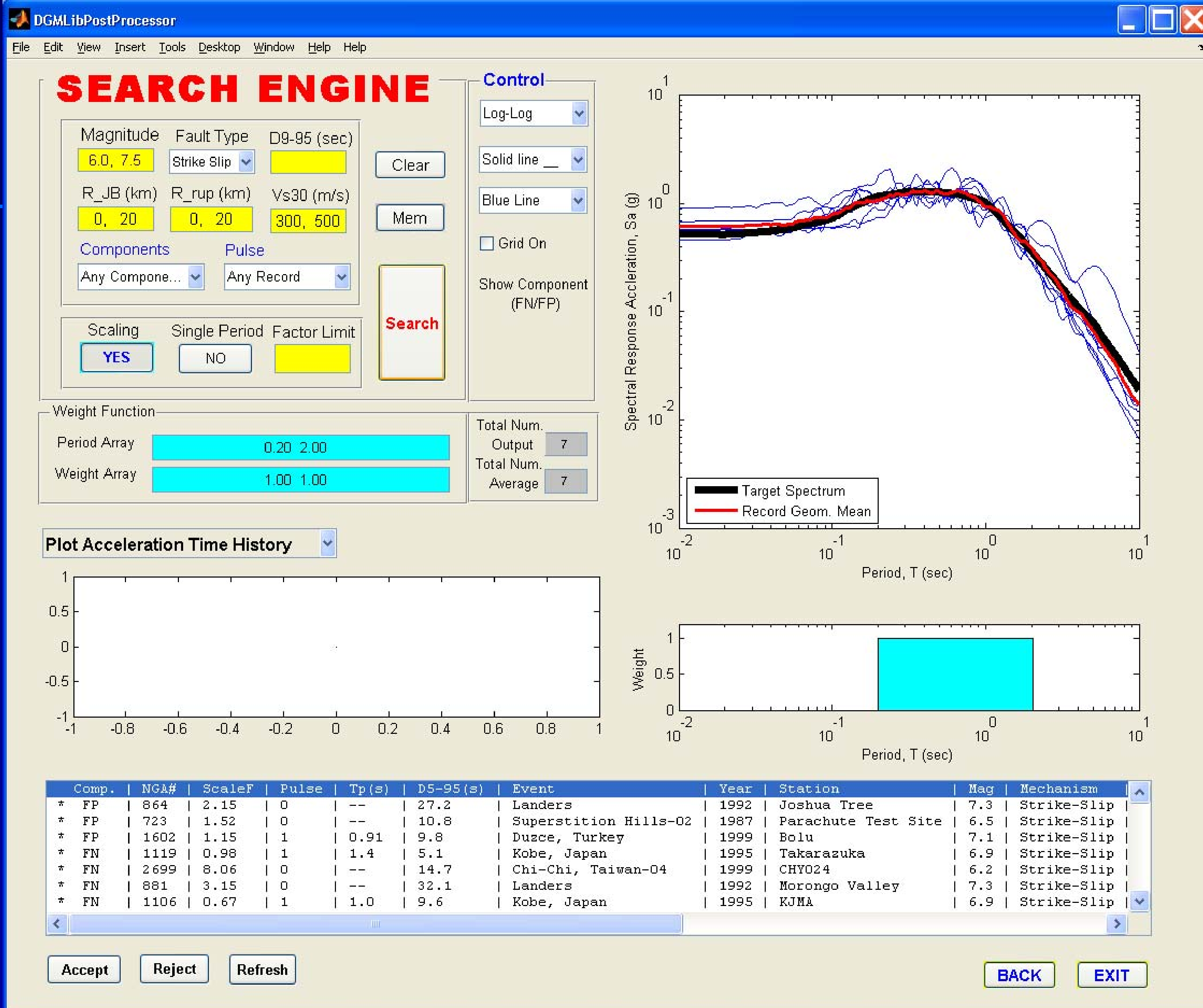
Flexibility in Defining Period Range and Weighting Function for Computing “Goodness of Fit” and Scaling Factor





Step 3: Evaluation of Records

- Tool scans data base, selects all records that meet criteria, scales records, if desired, to match target, and ranks records in order of increasing MSE.
- Provides list of selected records and information on MSE, scaling factor, metadata (M, R, V_{S30}, etc.), and file identification in NGA database.
- Plots average of scaled spectra for selected number of records vs. target spectrum
- Plots individual spectra
- Plots acceleration, velocity, or displacement time histories for individual records.



	Comp.	NGA#	ScaleF	Pulse	Tp(s)	D5-95(s)	Event	Year	Station	Mag	Mechanism
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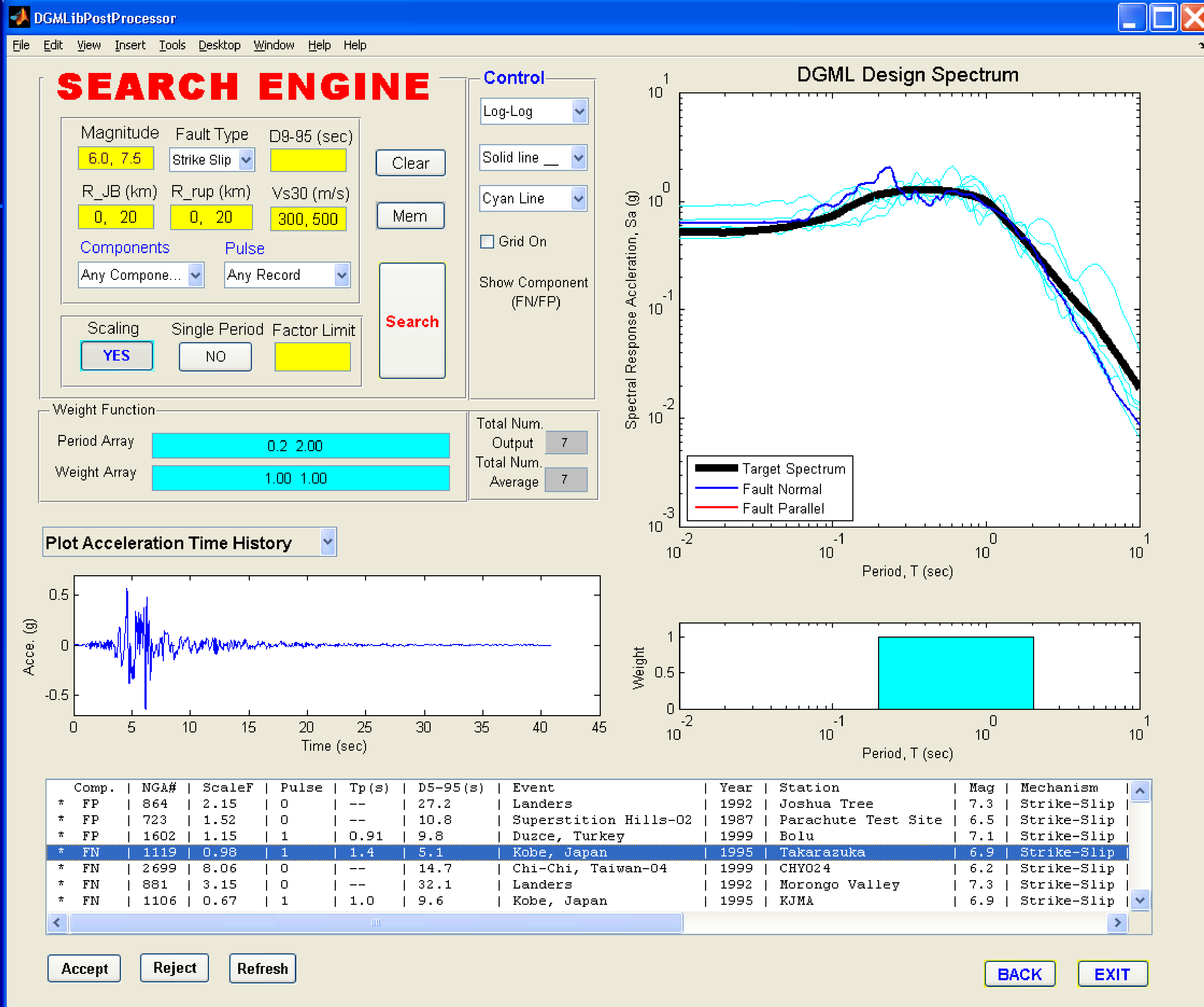
DGMLibPostProcessor
File Edit View Insert Tools Desktop Window Help Help
SEARCH ENGINE
Magnitude
6.0, 7.5
Fault Type
Strike Slip
D9-95 (sec)
R_JB (km)
0, 20
R_rup (km)
0, 20
Vs30 (m/s)
300, 500
Components
Any Compone...
Pulse
Any Record
Clear
Mem
Search
Scaling
YES
Single Period
NO
Factor Limit
Control
Log-Log
Solid line __
Cyan Line
Grid On
Show Component (FN/FP)
Weight Function
Period Array
0.2 2.00
Weight Array
1.00 1.00
Total Num. Output
7
Total Num. Average
7
DGML Design Spectrum
Spectral Response Accleration, Sa (g)
Target Spectrum
Fault Normal
Fault Parallel
Period, T (sec)
Plot Acceleration Time History
Acce. (g)
Time (sec)
Weight
Comp. | NGA# | ScaleF | Pulse | Tp(s) | D5-95(s) | Event | Year | Station | Mag | Mechanism |
* FP | 864 | 2.15 | 0 | -- | 27.2 | Landers | 1992 | Joshua Tree | 7.3 | Strike-Slip |
* FP | 723 | 1.52 | 0 | -- | 10.8 | Superstition Hills-02 | 1987 | Parachute Test Site | 6.5 | Strike-Slip |
* FP | 1602 | 1.15 | 1 | 0.91 | 9.8 | Duzce, Turkey | 1999 | Bolu | 7.1 | Strike-Slip |
* FN | 1119 | 0.98 | 1 | 1.4 | 5.1 | Kobe, Japan | 1995 | Takarazuka | 6.9 | Strike-Slip |
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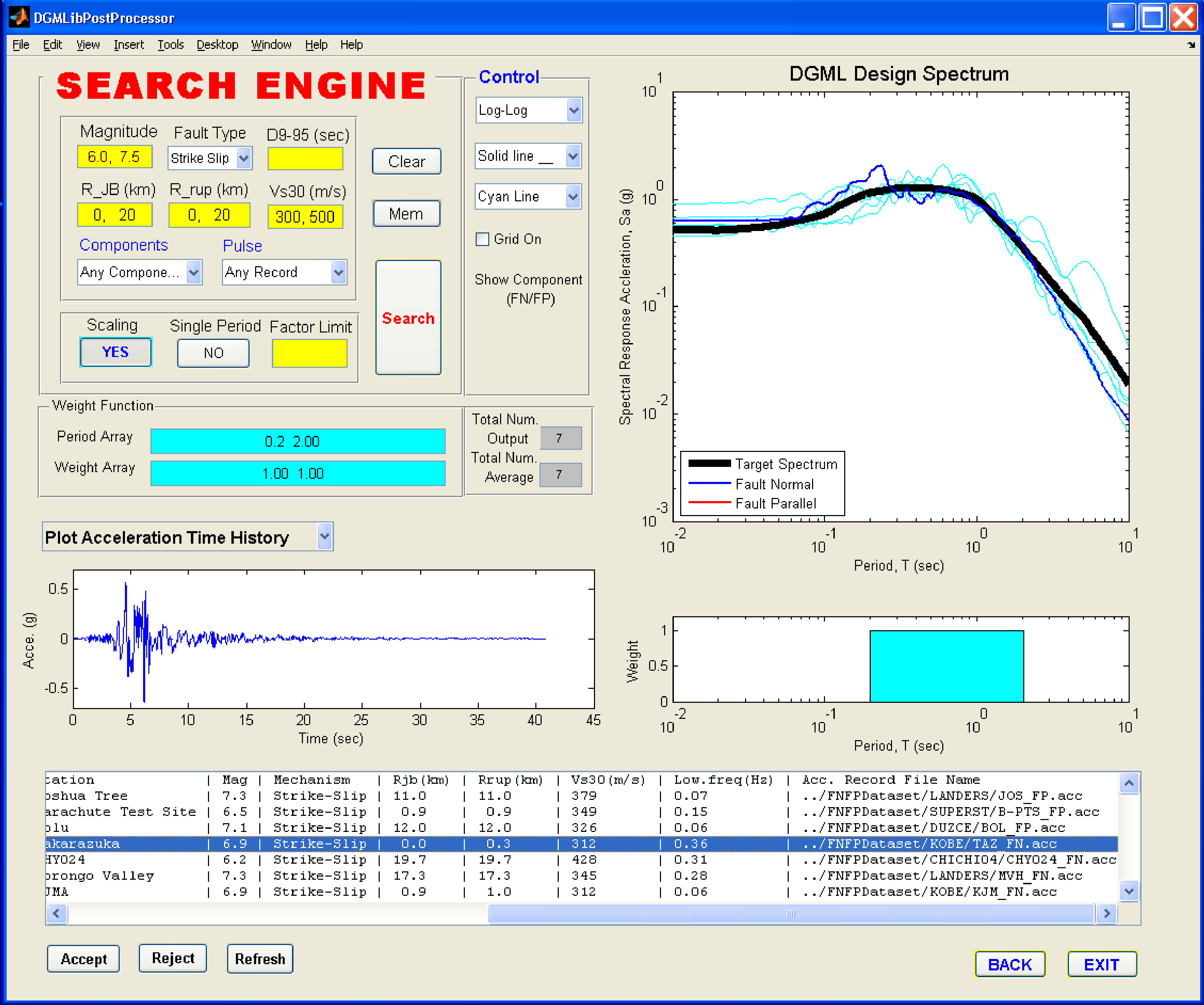
* FN | 881 | 3.15 | 0 | -- | 32.1 | Landers | 1992 | Morongo Valley | 7.3 | Strike-Slip |
* FN | 1106 | 0.67 | 1 | 1.0 | 9.6 | Kobe, Japan | 1995 | KJMA | 6.9 | Strike-Slip |
Accept
Reject
Refresh
BACK
EXIT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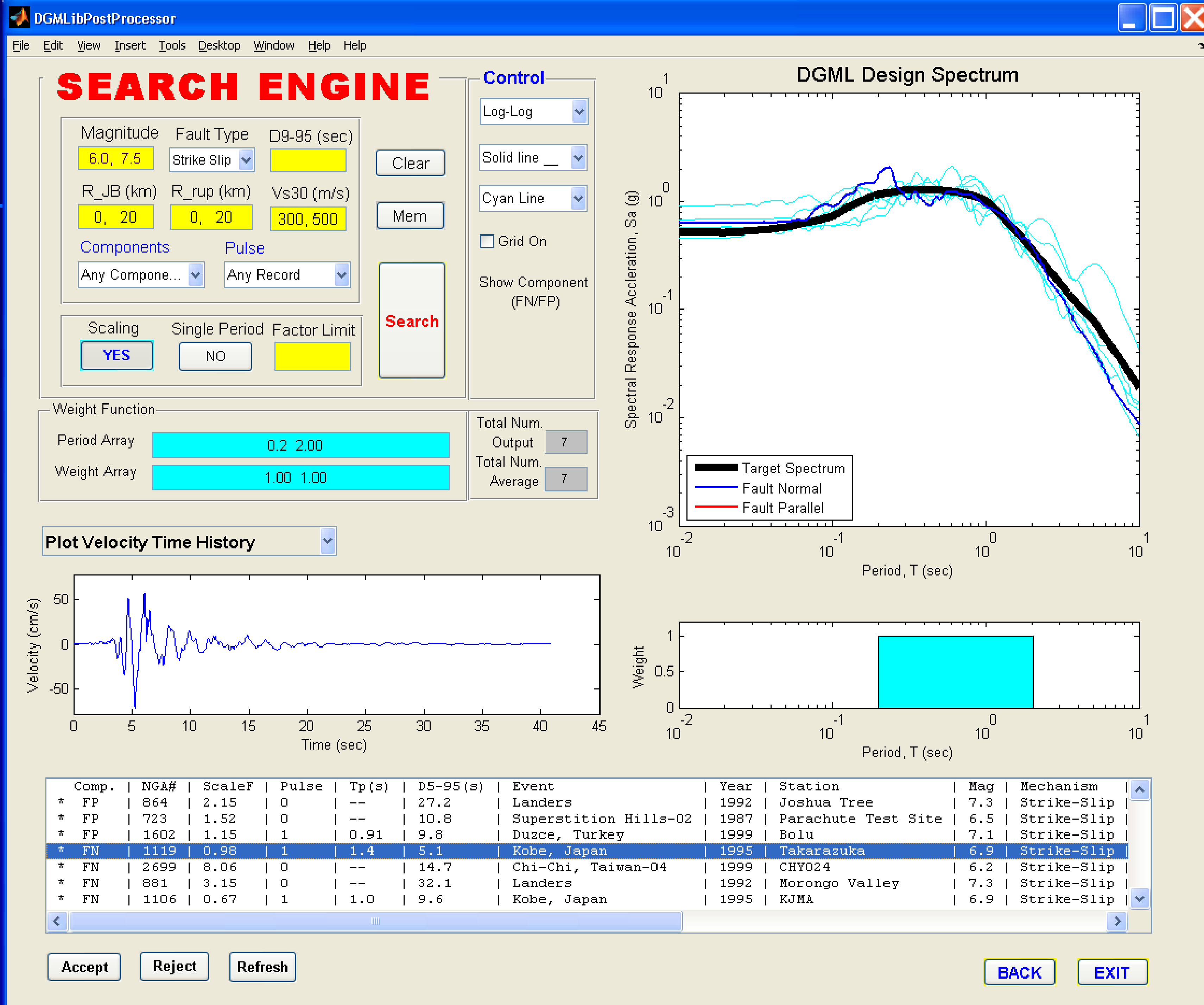
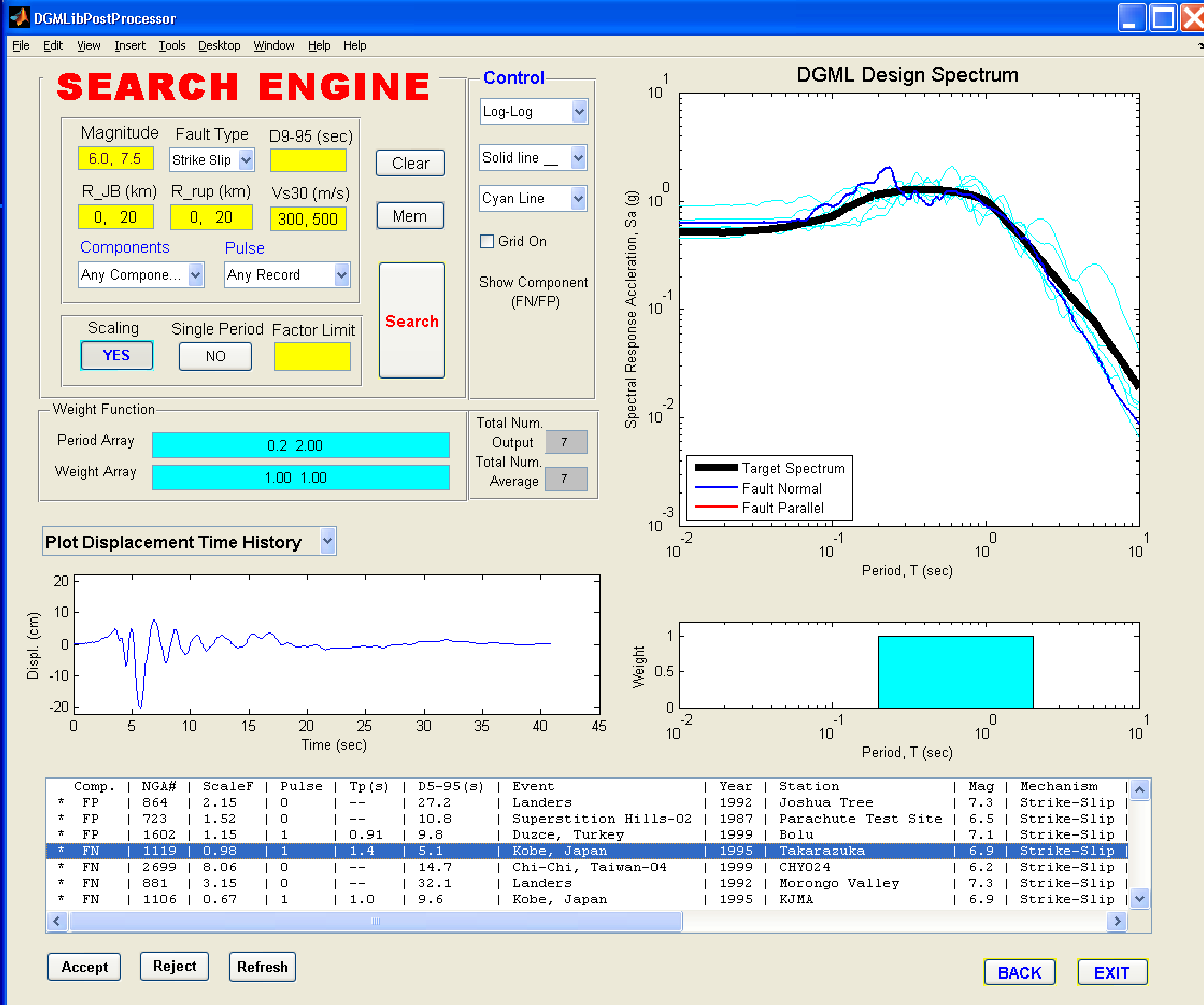
SEARCH ENGINE
Magnitude
Fault Type
D9-95 (sec)
6.0, 7.5
Strike Slip
R_JB (km)
R_rup (km)
Vs30 (m/s)
0, 20
0, 20
300, 500
Components
Pulse
Any Compone...
Any Record
Scaling
Single Period
Factor Limit
YES
NO
Clear
Mem
Search
Control
Log-Log
Solid line __
Cyan Line
Grid On
Show Component (FN/FP)
Weight Function
Period Array
0.2 2.00
Weight Array
1.00 1.00
Total Num. Output
7
Total Num. Average
7
Plot Acceleration Time History
Acce. (g)
Time (sec)
DGML Design Spectrum
Spectral Response Accleration, Sa (g)
Period, T (sec)
Target Spectrum
Fault Normal
Fault Parallel
Weight
Period, T (sec)
cation | Mag | Mechanism | Rjb(km) | Rrup(km) | Vs30(m/s) | Low.freq(Hz) | Acc. Record File Name
oshua Tree | 7.3 | Strike-Slip | 11.0 | 11.0 | 379 | 0.07 | ../FNFPDataset/LANDERS/JOS_FP.acc
arachute Test Site | 6.5 | Strike-Slip | 0.9 | 0.9 | 349 | 0.15 | ../FNFPDataset/SUPERST/B-PTS_FP.acc
olu | 7.1 | Strike-Slip | 12.0 | 12.0 | 326 | 0.06 | ../FNFPDataset/DUZCE/BOL_FP.acc
akarazuka | 6.9 | Strike-Slip | 0.0 | 0.3 | 312 | 0.36 | ../FNFPDataset/KOBE/TAZ_FN.acc
HY024 | 6.2 | Strike-Slip | 19.7 | 19.7 | 428 | 0.31 | ../FNFPDataset/CHICHI04/CHY024_FN.acc
orongo Valley | 7.3 | Strike-Slip | 17.3 | 17.3 | 345 | 0.28 | ../FNFPDataset/LANDERS/MVH_FN.acc
JMA | 6.9 | Strike-Slip | 0.9 | 1.0 | 312 | 0.06 | ../FNFPDataset/KOBE/KJM_FN.acc
Accept
Reject
Refresh
BACK
EXIT


DGMLibPostProcessor
File Edit View Insert Tools Desktop Window Help Help
SEARCH ENGINE
Magnitude
6.0, 7.5
Fault Type
Strike Slip
D9-95 (sec)
R_JB (km)
0, 20
R_rup (km)
0, 20
Vs30 (m/s)
300, 500
Components
Any Compone...
Pulse
Any Record
Clear
Mem
Search
Scaling
YES
Single Period
NO
Factor Limit
Control
Log-Log
Solid line __
Cyan Line
Grid On
Show Component (FN/FP)
Weight Function
Period Array
0.2 2.00
Weight Array
1.00 1.00
Total Num. Output
7
Total Num. Average
7
DGML Design Spectrum
Spectral Response Accleration, Sa (g)
Target Spectrum
Fault Normal
Fault Parallel
Period, T (sec)
Weight
Period, T (sec)
Plot Velocity Time History
Velocity (cm/s)
Time (sec)
Comp. | NGA# | ScaleF | Pulse | Tp(s) | D5-95(s) | Event | Year | Station | Mag | Mechanism |
* FP | 864 | 2.15 | 0 | -- | 27.2 | Landers | 1992 | Joshua Tree | 7.3 | Strike-Slip |
* FP | 723 | 1.52 | 0 | -- | 10.8 | Superstition Hills-02 | 1987 | Parachute Test Site | 6.5 | Strike-Slip |
* FP | 1602 | 1.15 | 1 | 0.91 | 9.8 | Duzce, Turkey | 1999 | Bolu | 7.1 | Strike-Slip |
* FN | 1119 | 0.98 | 1 | 1.4 | 5.1 | Kobe, Japan | 1995 | Takarazuka | 6.9 | Strike-Slip |
* FN | 2699 | 8.06 | 0 | -- | 14.7 | Chi-Chi, Taiwan-04 | 1999 | CHY024 | 6.2 | Strike-Slip |
* FN | 881 | 3.15 | 0 | -- | 32.1 | Landers | 1992 | Morongo Valley | 7.3 | Strike-Slip |
* FN | 1106 | 0.67 | 1 | 1.0 | 9.6 | Kobe, Japan | 1995 | KJMA | 6.9 | Strike-Slip |
Accept
Reject
Refresh
BACK
EXIT



	Comp.	NGA#	ScaleF	Pulse	Tp(s)	D5-95(s)	Event	Year	Station	Mag	Mechanism
*	FP	864	2.15	0	--	27.2	Landers	1992	Joshua Tree	7.3	Strike-Slip
*	FP	723	1.52	0	--	10.8	Superstition Hills-02	1987	Parachute Test Site	6.5	Strike-Slip
*	FP	1602	1.15	1	0.91	9.8	Duzce, Turkey	1999	Bolu	7.1	Strike-Slip
*	FN	1119	0.98	1	1.4	5.1	Kobe, Japan	1995	Takarazuka	6.9	Strike-Slip
*	FN	2699	8.06	0	--	14.7	Chi-Chi, Taiwan-04	1999	CHY024	6.2	Strike-Slip
*	FN	881	3.15	0	--	32.1	Landers	1992	Morongo Valley	7.3	Strike-Slip
*	FN	1106	0.67	1	1.0	9.6	Kobe, Japan	1995	KJMA	6.9	Strike-Slip

Report Listing Selected Records and Their Characteristics

Comp.	NGA#	ScaleF	Pulse	Tp(s)	D5-95(s)	Event	Year	Station	Mag	Mechanism	Rjb(km)	Rrup(km)	Vs30(m/s)	Low.freq(Hz)	Acc. Record File Name
FN	171	1	1	3.3	6.2	Imperial Valley-06	1979	EC Meloland Overpass FF	6.5	Strike-Slip	0.1	0.1	186	0.13	../FNFPDataset/IMPVALL/H-EMO_FN.acc
FN	727	1	0	--	12.1	Superstition Hills-02	1987	Superstition Mtn Camera	6.5	Strike-Slip	5.6	5.6	362	0.38	../FNFPDataset/SUPERST/B-SUP_FN.acc
FN	189	1	0	--	8.5	Imperial Valley-06	1979	SAHOP Casa Flores	6.5	Strike-Slip	9.6	9.6	339	0.25	../FNFPDataset/IMPVALL/H-SHP_FN.acc
FN	183	1	1	5.4	5.8	Imperial Valley-06	1979	El Centro Array #8	6.5	Strike-Slip	3.9	3.9	206	0.13	../FNFPDataset/IMPVALL/H-E08_FN.acc
FP	1116	1	0	--	9.4	Kobe, Japan	1995	Shin-Osaka	6.9	Strike-Slip	19.1	19.1	256	0.13	../FNFPDataset/KOBE/SHI_FP.acc
FN	178	1	1	5.2	14.2	Imperial Valley-06	1979	El Centro Array #3	6.5	Strike-Slip	10.8	12.9	163	0.13	../FNFPDataset/IMPVALL/H-E03_FN.acc
FP	170	1	0	--	8.3	Imperial Valley-06	1979	EC County Center FF	6.5	Strike-Slip	7.3	7.3	192	0.13	../FNFPDataset/IMPVALL/H-ECC_FP.acc
FP	174	1	0	--	8.6	Imperial Valley-06	1979	El Centro Array #11	6.5	Strike-Slip	12.4	12.4	196	0.25	../FNFPDataset/IMPVALL/H-E11_FP.acc
FP	722	1	1	2.1	13.4	Superstition Hills-02	1987	Kornbloom Road (temp)	6.5	Strike-Slip	18.5	18.5	207	0.19	../FNFPDataset/SUPERST/B-KRN_FP.acc
FN	184	1	1	5.9	6.9	Imperial Valley-06	1979	El Centro Differential Array	6.5	Strike-Slip	5.1	5.1	202	0.13	../FNFPDataset/IMPVALL/H-EDA_FN.acc
FN	175	1	0	--	19.4	Imperial Valley-06	1979	El Centro Array #12	6.5	Strike-Slip	17.9	17.9	197	0.13	../FNFPDataset/IMPVALL/H-E12_FN.acc
FN	722	1	0	--	13.8	Superstition Hills-02	1987	Kornbloom Road (temp)	6.5	Strike-Slip	18.5	18.5	207	0.19	../FNFPDataset/SUPERST/B-KRN_FN.acc
FP	184	1	1	2	6.4	Imperial Valley-06	1979	El Centro Differential Array	6.5	Strike-Slip	5.1	5.1	202	0.13	../FNFPDataset/IMPVALL/H-EDA_FP.acc
FN	1618	1	0	--	14.5	Duzce, Turkey	1999	Lamont 531	7.1	Strike-Slip	8	8	660	0.07	../FNFPDataset/DUZCE/53_FN.acc
FN	187	1	0	--	17.6	Imperial Valley-06	1979	Parachute Test Site	6.5	Strike-Slip	12.7	12.7	349	0.13	../FNFPDataset/IMPVALL/H-PTS_FN.acc
FP	725	1	0	--	14.1	Superstition Hills-02	1987	Poe Road (temp)	6.5	Strike-Slip	11.2	11.2	207	0.25	../FNFPDataset/SUPERST/B-POE_FP.acc
FN	721	1	1	2.4	18.8	Superstition Hills-02	1987	El Centro Imp. Co. Cent	6.5	Strike-Slip	18.2	18.2	192	0.13	../FNFPDataset/SUPERST/B-ICC_FN.acc
FP	162	1	0	--	14.5	Imperial Valley-06	1979	Calexico Fire Station	6.5	Strike-Slip	10.4	10.4	231	0.25	../FNFPDataset/IMPVALL/H-CXO_FP.acc
FP	864	1	0	--	27.2	Landers	1992	Joshua Tree	7.3	Strike-Slip	11	11	379	0.07	../FNFPDataset/LANDERS/JOS_FP.acc
FP	175	1	0	--	19.1	Imperial Valley-06	1979	El Centro Array #12	6.5	Strike-Slip	17.9	17.9	197	0.13	../FNFPDataset/IMPVALL/H-E12_FP.acc
FN	170	1	1	4.5	14.9	Imperial Valley-06	1979	EC County Center FF	6.5	Strike-Slip	7.3	7.3	192	0.13	../FNFPDataset/IMPVALL/H-ECC_FN.acc
FN	158	1	1	2.4	7.1	Imperial Valley-06	1979	Aeropuerto Mexicali	6.5	Strike-Slip	0	0.3	275	0.06	../FNFPDataset/IMPVALL/H-AEP_FN.acc
FN	180	1	1	4	9.4	Imperial Valley-06	1979	El Centro Array #5	6.5	Strike-Slip	1.8	4	206	0.13	../FNFPDataset/IMPVALL/H-E05_FN.acc
FP	1106	1	0	--	8.1	Kobe, Japan	1995	KJMA	6.9	Strike-Slip	0.9	1	312	0.06	../FNFPDataset/KOBE/KJM_FP.acc
FN	179	1	1	4.6	10.2	Imperial Valley-06	1979	El Centro Array #4	6.5	Strike-Slip	4.9	7	209	0.13	../FNFPDataset/IMPVALL/H-E04_FN.acc
FN	1611	1	0	--	14.1	Duzce, Turkey	1999	Lamont 1058	7.1	Strike-Slip	0.2	0.2	425	0.07	../FNFPDataset/DUZCE/105_FN.acc
FP	164	1	0	--	29.7	Imperial Valley-06	1979	Cerro Prieto	6.5	Strike-Slip	15.2	15.2	660	0.13	../FNFPDataset/IMPVALL/H-CPE_FP.acc
FN	162	1	0	--	11.2	Imperial Valley-06	1979	Calexico Fire Station	6.5	Strike-Slip	10.4	10.4	231	0.25	../FNFPDataset/IMPVALL/H-CXO_FN.acc
average					12.98				6.60		9.43	9.67	272.86		

DGML Interactive Software with Graphic Interface

- Interactive software package for DGML has been developed based on capability of Matlab's Graphic User Interface.
  - Graphic User Interface: User interface for data input and processing, e.g. checking boxes, selecting pop-up menus, pushing buttons. Capability to retrieve previously specified input data.
  - Interactive Plotting: Results can be visualized in real time with average spectra and individual time histories and their response spectra plotted.

(continued)

DGML Interactive Software with Graphic Interface (continued)

- Flexibility: Different criteria can be used to select records. Option for scaling or not-scaling records. Option for selecting record on basis of spectrum of a single record or geometric mean of FN and FP components. Option for selecting records with pulses. User specifies number of records. User can manually select certain records
- Efficiency: Efficient algorithm permits sorting of PEER-NGA data base within seconds.
- Extendibility: DGML package can be readily upgraded to accommodate future NGA database development.

DGML Distribution

- Beta version for project review currently implemented in MATLAB on a DVD
- Planned release as a web-based tool
  - Incorporation of review panel comments
  - Incorporation of final PEER-NGA models
  - Incorporation of updated correlation model for constructing conditional mean spectra