

Time Series Selection and Modification

Summary of Working Group Meeting

10am – 2pm May 15, 2006

PEER Headquarters

Participants: Norm Abrahamson, Yousef Bozorgnia, Brian Chiou, Allin Cornell, Christine Goulet, Curt Haselton, Nico Luco, Tom Shantz, Polsak Tothong and Jennie Watson-Lamprey

There are many methods of time series selection and modification for use in nonlinear dynamic analyses available to the engineer. At this time there is no consensus as to the best method and thus the choice of a method is largely subjective. This has had a great impact on the engineering community because nonlinear response is sensitive to the selection and modification of time series.

The working group has two roles: (a) Management role (to decide about future workshops, funding projects, etc.); and (b) Technical role (to evaluate various methods; recommend future technical directions, etc.). The working group will examine various existing methods, recommend examination of other methods; and determine a basis for evaluation of time series selection and modification methods, which will depend on the intended use of the time series.

The working group will make efforts to coordinate with other contemporary projects and provide them with guidance for choosing a method of time series selection and modification. A tall buildings research contract with the San Francisco Building Department will be signed in coming weeks; Yousef will update the group on progress. The NEHRP 2008 provisions are currently being revised; Nico will update the group on possibilities for interaction. The DGML project is currently on hold and is looking for guidance for completion of the project goals.

In order to evaluate methods of time series selection and modification, the goal of the nonlinear dynamic analyses must be known and there must be a "true" value with which to compare. To perform the evaluation the group will:

1 – Identify the application for which time series are employed and clearly stating the goal of the application.

The focus of the working group is to evaluate time series selection and modification methods to be used for applications used in current practice.

Buildings: analyses are performed for validation of the design and to see if the engineer "missed anything."

Earth Structures: analyses are performed to define the basic performance of the earth structure (deformation or liquefaction potential), often only one time series is used (based on regulatory guidance).

Bridges: analyses are performed for validation purposes and for checking non-standard designs and areas of high ground motion.

The applications and goals discussed were determined to be lacking in specifics. A questionnaire is to be developed by Yousef and Jennie and distributed to practicing engineers to determine what they are trying to achieve when they perform dynamic nonlinear analyses using time series and any limitations on the parameters that can be used for selection (i.e. Do they know the fundamental period of the structure? Do they want to be able to use the same time series for reanalyses after model modifications?)

Next meeting: We will review the answers from the questionnaires and better define the applications.

2 – Develop an evaluation measure for the methods.

We will consider a simple test case using building models with newer construction practices and a single magnitude event on a single fault. For example, develop a suite of records from Mw7, Rrup 10km.

3 – Identify the candidate time series selection and modification methods to be examined.

Nico presented a list of methods that he put together. The methods shown were identified as being used for different applications. Nico is going to summarize the methods he listed in a document and attempt to identify the application that corresponds to each method.

Some of the methods he listed:

M & R bin

M & R bin, scale to $S_a(T_1)$

M & R bin, scale to UHS

M & R bin, scale to median response spectrum

M & R bin, and ϵ scale to $S_a(T_1)$

M & R bin, match to UHS

M & R bin, match to ϵ consistent spectrum

Inelastic response spectrum scaling

Plus a couple more...

While the focus of the working group is on current applications, the working group will also serve as a forum for active participation in the development of time series selection and modification methods that better meet the goals of nonlinear dynamic analyses.

Some forward thinking methods discussed at this meeting were:

Sa averaged over an interval as an improved IM

Sd inelastic as an improved IM
Floor accelerations as an important predictor of contents damage
Vector of multiple periods and yield forces to better approximate response

4 – Develop a work plan wherein group members will perform nonlinear analyses using models previously developed and employing the time series selection and modification methods identified by the group.

Tom brought to the attention of the group that Erol Kalkan at CSMIP would like to be involved in running analyses using models he has already developed. Tom has requested from the group that we provide Erol with a workplan that he can take to CSMIP for approval. Tom will provide the group with details of the structural models that Erol will be using at the next meeting.

Curt has developed models of code compliant reinforced concrete buildings that he is currently running with a focus on collapse. He expressed interest in running analyses using his models.

Next meeting: Develop a work plan for the group and a timeline for completion.

5 – Compare the results of the analyses using the evaluation measure and develop recommendations for the applications identified.

Before any recommendations can be made the group should hold meetings with a broader group involved in development of time series to solicit feedback. The COSMOS annual meeting was identified as a good forum for presentation. It will be held November 17th. PEER was identified as a potential co-sponsor. Norm and Jennie will coordinate to bring the working group results into the meeting.

A possible long-term goal for the group is the publication of a PEER report summarizing the results of the group.

To complete the goals of the working group in a reasonable time, we will hold regular meetings for whichever group members are able to attend. The meetings will be held at PEER. The dates for the next four meetings are: **June 26th, July 17th, August 21st and September 18th.**

Additional issues identified:
Time series selection for shake table testing
Two component selection and scaling
Improved bin width guidance