GENERALIZED MASING MODELING OF HYSTERETIC DETERIORATING BEHAVIOR

SEYED ALI ASHRAFI* AND ANDREW W. SMYTH †

* Department of Civil Engineering
and Engineering Mechanics
Columbia University
New York, NY 10027-6699

† Department of Civil Engineering
and Engineering Mechanics
Columbia University
New York, NY 10027-6699
smyth@civil.columbia.edu

The modeling of hysteretic behavior is of significant importance in mechanics. One important factor is how meaningful the parameters of a model are. Physically meaningful parameters can give some information about the real properties of a system and make the task of selecting proper parameter values, interpreting the data, tracking the changes in the system, and health monitoring easier. In this paper, the distributed element model (DEM) is used as a starting point, because it is physically meaningful and has a basis on microstructure of slip surfaces [1]. Deterioration is included in the model using Iwan's assumptions in [2]. This model is studied with particular focus on understanding how past history affects future response. It is shown that having the knowledge of a few milestones of the past displacement maxima/ minima, called the Sequence of Dominant Alternating Extremes (SDAE), will be enough to determine the complicated response without the need to keep track of every element. This will make the calculations very efficient. Also, many qualitative properties of the response will be known beforehand. It is observed that the non-deteriorating DEM follows Extended Masing behavior as defined in [3]. A Generalized Masing Approach is proposed by the authors that makes it possible to capture the deteriorating response to arbitrary loading as well using simple rules. In the proposed approach, there are only two root curves which define the response. As one simulates the response for a given model, one simply switches back and forth between the two curves. Depending on the changes in the global extreme displacement, one of these curves is occasionally updated. A direct link is presented between the parameters of the element yield distribution and the two curves determining the deteriorating response of the model. Hence, this approach is very useful and efficient both from the modeling/analysis, and from the identification point of view. The non-deteriorating DEM cannot have any stiffening while the deteriorating DEM can exhibit stiffening only under virgin loading for very special distributions. Pinching and rate-dependence can be added to the model through introduction of parallel elements. The generalized Masing behavior will stay valid for the model with pinching. However, for the rate-dependent model, the response of the rate-dependent element should be evaluated independently and then added to the rest of the model. Using the distribution functions to define the models, it is shown that this approach provides a simple efficient way to determine the response of many different models of a certain class to any arbitrary input. This formulation also provides an environment for identification of dynamic models of very different characteristics with a few meaningful parameters and renders the problem into identification of parameters fixed in time.

References

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