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Proposition

Optimal sensor positioning for large civil structures

Localisation : Irisa, Rennes

Team : SISTHEM

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Background: The SISTHEM team is working on identification and detection methods applied to the problem of ageing and damage prevention for civil structures. This yields to the monitoring of eigenvalues and modeshapes for a certain linear system corresponding to the discretisation of the model of the mechanical structure of interest, like in operation bridges. Those structures are assumed to be excited by some ambiant unknown non stationary and non controlled excitation. Under this assumption, from sensor measurements, SISTHEM team deals with output only identification or detection methods. One of the primary problems for civil engineering structures is damage detection and localization. Different methods have been proposed by the project and this subject builds upon localization results obtained previously. Most of earlier work took place during the CONSTRUCTIF ACI *S&I* project.

Damage detection techniques based on covariance driven subspace methods have been proposed [1]. These methods have been expended to localize damage and have been shown to be able to link finite elements models and correlation data in order to localize damage [2]. When the structure is large, too many sensors are required to cover the structure, especially if uniform placement is used. Optimal placement of sensors has to be used. A statistical criterion has been derived from the computation of both the finite element sensitivities and the damage detection test.

Subject : The student in charge of the work will have to test optimal sensor positioning on a real laboratory structure, using a finite element model and the time series from the structure. Different sensor selections in terms of number and position will be evaluated. The finite element model and the corresponding data will be provided from a collaboration with Harbin Institute of Technology, China.

References

[1] M. Basseville, L. Mevel, and M. Goursat. Statistical model-based damage detection and localization : subspace-based residuals and damage-to-noise sensitivity ratios. *Journal of Sound and Vibration*, 275(3):769–794, August 2004.

[2] E. Balmès, M. Basseville, L. Mevel, H. Nasser, et W. Zhou. Statistical model-based damage localization: a combined subspace-based and substructuring approach. *Structural Control and Health Monitoring*, 15(0):0–0, 2008.