23. <u>LINEAR DYNAMIC SIMULATION WITH A FASTER MODAL</u> <u>SOLVER</u>

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SUMMARY

Dynamic simulation is one essential component in any modem simulation package. This type of simulation studies the dynamic nature of structures and reveals fundamental characteristics of the objects to be studied. Due to its fundamental importance, it is widely used in many scientific and engineering fields, such as studies on vibration of a space shutter to ensure its safe operation and designs of an oversea bridge against unexpected earthquakes. Designers and engineers can use this simulation tool to further improve their designs for safety and cost saving purposes. In this presentation, we will focus on linear dynamic simulations based on the modal decomposition method. This method first performs a modal analysis on the whole structure. Then the real dynamic response is calculated by combining individual responses from each decomposed mode in almost real time.

Modal (eigenvalue) analysis is the key component in a linear dynamic simulation, and it is also the most computationally expensive part in such a simulation. Hours and even days spent on retrieving eigenvalues is not unusual for large scale models. A new fast eigenvalue solver is proposed in this presentation which combines Subspace algorithm and Algebraic Multi-Grid (AMG) linear equation solver, and it greatly reduced the time spent in solving such large scale eigenvalue problems. For a sample large assembly model with 3.9 million degree of freedoms, the solution time is reduced by 8 times comparing to the time spent by an industrial standard eigenvalue solver.

Finally, as an example, a dynamic simulation is performed on a 3-D bridge model with car traffic, wind and earthquake loads. Real time displacement and stress response results are presented.