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UC-SDRL CONSORTIUM IN EXPERIMENTAL STRUCTURAL DYNAMICS

Research Project Plan 2009

Project Goals: The primary goal for the Consortium Project for 2009 is the development of a Matlab® based data acquisition system, specialized to the needs of experimental structural dynamics. This project will be based upon the historical data acquisition software modules previously developed by the UC-SDRL (MRIT-VXI and MIMO-VXI) for use in experimental modal analysis but will integrate these two functions together with the needs of general structural dynamics data acquisition and with the needs of operational modal analysis. The scope of the project will be limited to VXI data acquisition hardware, originally provided by Hewlett Packard and Agilent, which is now available from VTI Instruments. This research project, when completed, will provide similar functionality as the SDRC/MTS IDEAS data acquisition software but will utilize a different Graphic User Interface (GUI) and will be enhanced for structural analysis data acquisition.

Period of Development: The project is expected to begin on July 1, 2009 if sufficient Consortium membership can be identified. The Consortium will initially meet and review plans during the IMAC activity in February 2010 in Jacksonville, FL. An initial alpha release of the data acquisition capability is expected to be available by that time. Subsequent testing and iteration will continue until June 30, 2010, at which time the project results will be available for use.

Project Details (Phase I): The project will integrate existing structural dynamics, data acquisition concepts into a single data acquisition system capable of general data acquisition but specifically focused on experimental structural dynamics. This will include specialized modules for estimating frequency response functions from impact testing and a variety of shaker testing methods, free-decay testing and generalized, output only time and frequency domain testing. Some ability to work with operational data will be provided for both general testing situations and specific rotational system situations (RPM spectral maps, Kalman filtering, etc.). A majority of the following specific characteristics of the proposed data acquisition project will be provided:

- Hardware reconfiguration will be available from software (physical channel to VXI card organization). Any hardware clock speed can be chosen to provide specific Fmax, delta F, delta T, or observed time T.
- Hardware will be limited to one mainframe (multiple independent mainframes, with independent controllers, may provide higher channel counts, in some testing situations, if reference channels are copied between the mainframes).
- Data I/O will include Universal File Format (UFF) and a documented, structured Matlab® array characteristic.

- Sensor/channel information will be accessible via import/export structures that include MS Excel, OpenOffice Calc, and Matlab® structured variable.
- Data management will utilize the current X-Modal II Data Manager that allows complete freedom to cut and paste data groups together to generate specific data group combinations.
- Long time records will be limited to VXI data acquisition card memory (1 Msample/channel if VXI card memory is available)
- DSP functions to include: Windowing, frequency shifted FFT (Zoom)
- Averaging functions to include: RMS averaging, cyclic averaging, random decrement averaging
- Specialized DSP functions for impact testing (force and exponential windows)
- Multiple, simultaneous source functions to include: Sine, chirp, random, pseudo-random, periodic random, burst random and hybrid random.
- Time functions to include: Time history, auto correlation, cross correlation
- Frequency domain functions to include: Linear spectra, auto power spectra (inputs and outputs), cross power spectra (input-input, output-output, input-output), power spectral density, single and multiple input frequency response functions (H1, Hv), ordinary and multiple coherence, virtual force, single and multiple input transmissibility.
- Other functions to include: Cepstra
- Graphic display formats to include: real, imaginary, complex, magnitude, log magnitude, phase, real/imaginary, magnitude/phase, log magnitude/phase, magnitude/coherence, log magnitude/coherence, magnitude/phase/coherence, log magnitude/phase/coherence
- Graphic display export will utilize Matlab® export capabilities that include jpg, wmf, gif, eps, etc.

Project Extensions – Future (Phase II, III, ?): Once the initial project is complete, other extensions will be added, according to Consortium member interest and support. Some planning for the following extensions will be included in the initial development to allow these additions with a minimum of project restructuring. Based upon available support, some of the following extensions may be implemented in Phase I. Some possible extensions include:

- Long time records to disc (ADC ThruPut), either VXI or external disc drives.
- Multi-mainframe hardware capability (single controller).
- Multi-source sine/sine sweep shaker control with specific frequency and magnitude/phase relationships for each of up to six sources including ramp on/off, frequency step size, amplitude/phase/frequency feedback monitoring and control
- Transducer Electronic Data Sheet (TEDS) support.
- Shock response spectra and other transient test methods.
- Independently controlled multi-source shaker control with random, pseudo-random, periodic random, burst random and hybrid combinations of these signals for up to six shakers.
- Specialized structural dynamics testing methods, such as MIMO Forced Normal Mode (force appropriation), MIMO Phased Sine, SIMO Nonlinear Backbone, Nonlinear Frequency Domain Polynomial, etc.
- Other functionality based upon request and Consortium interest level.