MB Millenium™
Dynamic Test Controllers
...and Continuous Innovation of Test Processes for
VIBRATION · SHOCK · FORCE · LINEAR & ROTARY MOTION

MIMO Control System
Multi-Axis Vibration Control

"Our just installed 4/5 DOF BSR exciter suite is fantastically quiet and multi-functional. I believe this new MB system will contribute to fill the gap between the current test standards and the real world situation with its multi-DOF MIMO control features. The system will serve for BSR detection tests for seats and automobile interior parts/modules per GM, FORD and other global specifications and also for full vehicles through direct-body-excitation (DBE)."

Jun, Yong-Du, Ph. D., Professor and Director,
Kongju National University
Advanced Motor Parts Regional Innovation Center,
(AMP.RIC), Korea


**4/5 DOF BSR Energizer System installed at the
Advanced Motor Parts Regional Innovation Center (AMP.RIC),
Kongju National University (KNU), Korea**

Controller Specifications include:

- Up to 8 outputs, up to 16 inputs – handles up to 8 exciters
- 24-bit delta sigma ADC's, 50,000 Sps/channel, simultaneous sampling
- Sensor types: Acceleration, Velocity, Displacement, Encoder, Force, Angular Position/Rate, Torque
- Inputs: AC- or DC-coupled, IEPE at 4 mA. All software selectable
- Individually isolated outputs to eliminate ground loops between controller and amplifiers
- Differential inputs for low noise and to eliminate ground loops between controller and shaker
- DIO functions: controller-initiated or externally-initiated commands to/from test equipment powered from internal isolated supply
- Capability of 10 kHz control bandwidth; 0.10 Hz min frequency
- Up to 32,000 spectral lines
- Dynamic cross-coupling compensation as a function of frequency, that achieves coherence at largely > 0.9 and phase within ≤15° for like axes over the 100Hz bandwidth resulting in rectilinear motion in 3 orthogonal directions from multiple actuators
- Amplitude Control Accuracy: errors typically ≤5% for Time History & Sine Control; for Random, ±1dB on PSDs & ≤5% on gRMS
- Square matrix control method uses one control accelerometer input for each actuator output to control the 6 rigid-body DOFs

- Non-square matrix control available, if needed, to use more control accelerometers than actuators to control test article resonances
- Coordinate transformation to map control accelerometer responses to achieve the 6 control DOFs at measured test data locations
- Coordinate transformation provides ability to control or suppress rigid-body rotations
- Notching of any control channel response as necessary to control high-Q test article resonances by defining the notch bandwidth & depth of the notch for Time History, PSD Random and Sine
- Random-on-Time History technology provides superior PSD random control, converges quickly, and saves test time
- Skewness, Kurtosis and Crest Factor control; enabled or disabled
- Proprietary fusion of frequency domain (Fourier) and time-domain (PID) control laws delivers superior control of chaotic payloads
- Import from ASCII, Excel, and RPC-III (UFF); export to Excel
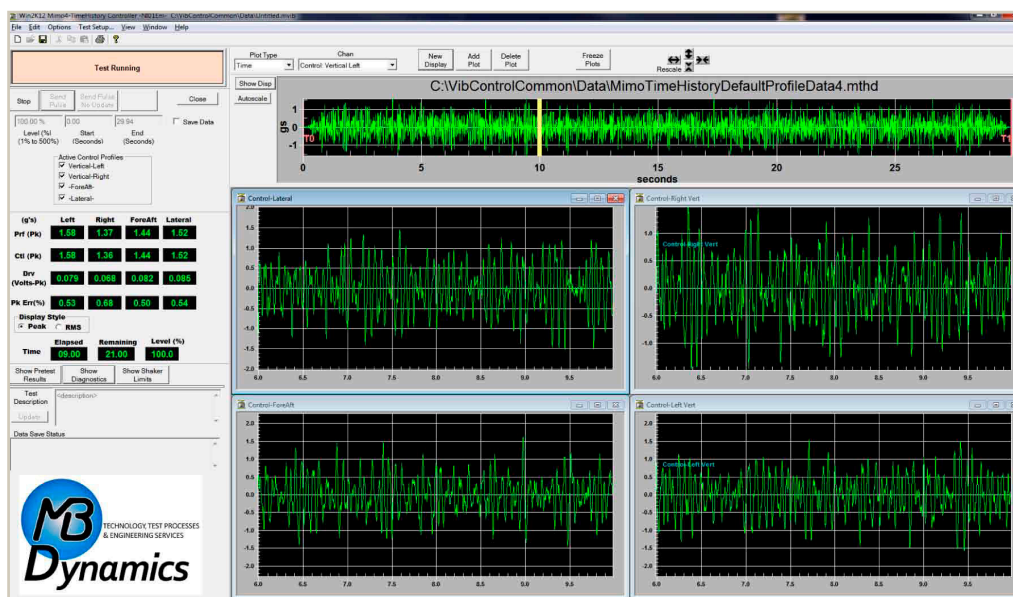
MB Millenium™

The MB Millenium™ MIMO Controller provides superior Time History control in this 4-axis test

This MB Millenium™ MIMO controller replicates actual-use vibration conditions by simultaneously controlling up to eight actuators connected to one test item running independent vibration profiles, synchronized or unsynchronized. MIMO shaker control applications include time history replication and random vibration (PSD control), as well as single-shaker and multi-shaker sine with user-defined frequency and phase relationships.

Practical MB hardware features and functions from 40+ years of applications know-how honed by doing vibration and dynamics tests augment commercially-available, continuously-innovated A/D and D/A hardware. The MB Millenium™ MIMO controls electro-dynamic, electromagnetic, pneumatic, and hydraulic actuators as well as linear and rotary motion control test systems. Profiles are acceleration, velocity, displacement, force, motion – and mixed profiles to simulate the end-use environment. A test item's "End-Use" vibration environment imposes multiple load inputs from multiple directions. A realistic test lab simulation should do the same. MB's Millenium MIMO makes it reliable and affordable:

- Oversee tests with clean and simple displays of control, monitor and drive signals; time and frequency domain
- Error-check test condition with pre-test loop check
- Protect test item & equipment with continuous loop checks
- Minimize time from road or field data to running tests with extensive tools for reducing field data and developing test profiles
- Minimize risks due to faulty cables & test equipment

MIMO (multiple input, multiple output) shaker control applications include time history replication and PSD random, as well as single-shaker sine and dual-shaker sine with the same frequency sweep schedule and a user-defined phase relationship between the two. Classical shock pulses are controlled using time history. Resonant search & dwell is available for single-shaker use. MIMO sine-on-random and random-on random can be available. Distinctly different limit profiles with dedicated alarms and aborts can be set up for each shaker. The MB Millenium MIMO software is a natural continuation of real-time signal processing work commenced in 1980, that includes under-constrained, noisy (non-Gaussian noise) multi-degree of freedom dynamic systems. Techniques and proprietary algorithms incorporated into this MIMO implementation include impulse response conditioning, time-domain feedback, and predictive noise-quelling. MIMO uses an ingenious implementation of classic algorithms plus novel treatments and represents continuous improvement of the MB Win2K5, Win2001 and earlier vibration control products on workstations and PCs.

Safety

- Manual abort via ESC key, software button on GUI, or facility E-STOP can be connected
- Pre-test controlled and limited to maximum pretest level, assures drive waveform is compared to response
- Continuous loop check for safety and protection
- Shutdown on open loop, loss of control signal, exceedance of abort and RMS level

TECHNOLOGY, TEST PROCESSES & ENGINEERING SERVICES

Dynamics

25865 Richmond Road · Cleveland OH · 44146 USA
phone +1 216 292 5850 · fax +1 216 292 5614
www.mbdynamics.com

Millenium™ is a trademark of MB Dynamics.