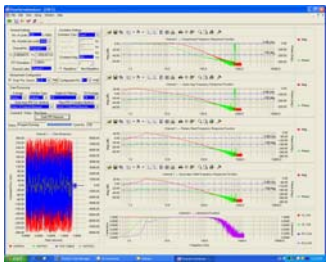
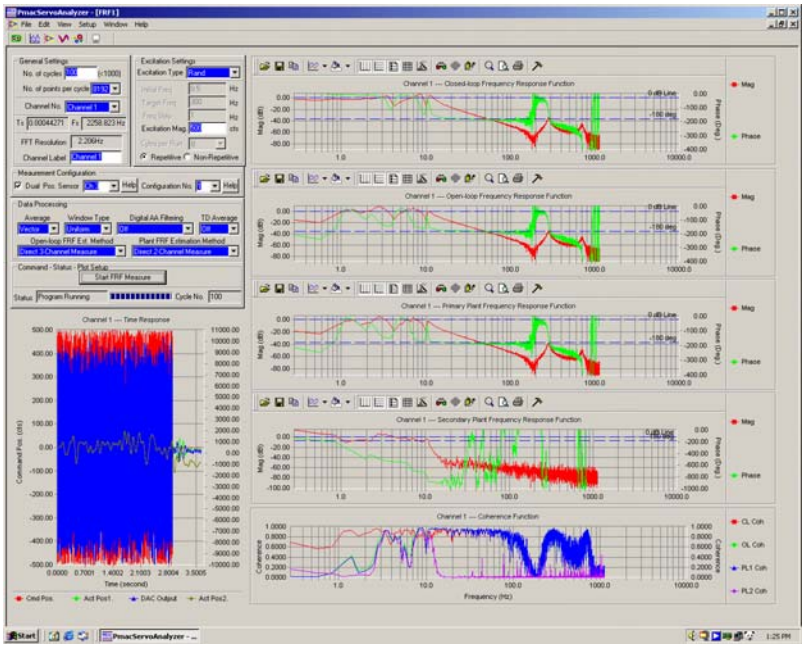
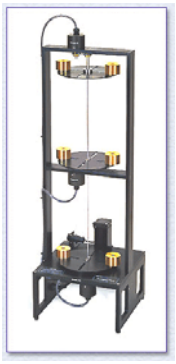
PMAC Dynamic Servo Analyzer

Bode Plot generated for system identification by PMAC Dynamic Servo Analyzer for a **Flexible** or **Rigid** body mechanical structure.



Rigid Body Mechanical Structure





Flexible Mechanical Structure

- Bode Plot is generated by using a selectable white noise or other excitation.
- Bode plot data can be used to derive the mechanical transfer function by non-linear curve fitting.
- Final step is to derive an automatically generated PMAC servo algorithm for the application.

The PMAC Servo Analyzer

The latest addition to PMAC's Servo Loop Tuning software tool is being developed as a comprehensive package that includes PMAC Servo Analyzer, PMAC Servo Simulator and PMAC Advanced Servo (Control Law) Designer. The PMAC Servo Analyzer, which accomplishes the classical *FFT*-based frequency response model identification.

Explicit Plant system modeling is an essential first step in the design of robust, high performance closed loop motion systems. The accuracy of the Plant model directly affects the behavior of the closed-loop system in terms of stability, speed of response (bandwidth), damping, and robustness to parameter changes. Among the several standard model identification methods, the *frequency response function* (FRF) identification is the most popular.

This method is based upon FFT technologies. In the PMAC Servo Analyzer, the FFT-based frequency response function is measured and estimated through a *chirp* or a *random* signal excitation applied to the closed loop state. With corresponding data gathered from PMAC, *the cross power*

spectrum between the input and output signals and the *auto-power spectrum* of the input signal are calculated from FFT, and then the ratio of the *cross power spectrum* over the *auto-power spectrum* is used to estimate the frequency response function between the input and output signals.

This procedure enables a rapid estimation of the Plant, the Open Loop and the Closed Loop Bode plots for any PMAC-controlled position control system. Additional configuration parameters and choices such as the number of position sensors (for dual feedback systems), various windowing, averaging, and filtering techniques are provided for experienced users in order to enhance the robustness of their Bode plot models.

The PMAC Servo Analyzer package can estimate up to four frequency response functions for one specified PMAC Motor Channel::

- Closed Loop transfer function for system performance
- Open Loop transfer function for system robustness and stability
- Plant transfer function for system modeling
- Secondary Plant transfer function for the dual feedback configuration.

These transfer functions can be estimated within a few seconds (or less), depending on the number of sample per measurement and the sampling frequency.

In this package, we support two types of measurement configurations depending on the location of external excitation. The first configuration has the excitation at the location of Commanded Position. The second configuration has the excitation at the location of Command Torque. Both configurations are established experimental model estimation techniques for the derivation of the above four transfer functions. The number of point per measurement directly affects the frequency resolution of the FFT and the time of measurement. The typical numbers of sample per measurement are powers of 2 (e.g., 1024, 2048, 4096, etc). The package supports a maximum of 16384 and a minimum of 512.