

User Solution

Test System Captures Heart Valve Sounds Using LabVIEW and DAQ Boards

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Structural Acoustics, a company that has been solving structure-born noise problems for 15 years, recently used LabVIEW for Windows in a unique electro-mechanical system for testing prosthetic heart valves.

Mechanically, the system replicates the pumping action of the heart's left ventricle to load a prosthetic valve in either the aortic or mitral position. Several sensors measure aortic and ventricular pressure, ventricular sound, aortic flow, ventricular volume, and strain on critical valve components. The system plays a key role in a development program for building an acoustic diagnostic procedure for prosthetic heart valves. The procedure analyzes the clicking sound of a valve to determine the mechanical integrity of key components.

The demands placed on the test system are constantly changing as the acoustic programs mature. LabVIEW has really helped us respond! By simplifying the creation of a graphical user interface (GUI), the coding needed to acquire more channels, filter data to remove noise, or reformat data has become a more manageable task.

Ventricular Simulator and LabVIEW

The test system has several components: an artificial ventricle and circulatory flow loop; an analog servo-pump controller that accepts a necessary ventricular pressure

The LabVIEW graphical programming language, which is highly efficient, becomes second nature very quickly.

waveform and closes a feedback loop around the ventricle; a 386SX-33 PC running a custom waveform editor that generates the necessary pressure waveform; a trigger to pace the data acquisition (DAQ) hardware; a custom sensor interface; and finally, a 486DX-66 PC equipped with two National Instruments AT-MIO-16F DAQ boards running the Windows version of LabVIEW.

LabVIEW runs on the 486DX PC and acquires data while the system is pumping. The custom sensor interface takes care of signal conditioning. The sensor interface drives all of the sensors, amplifies their low-



The electromechanical system formed by Structural Acoustics uses Windows-based LabVIEW and DAQ boards on a PC to perform an acoustic diagnostic procedure on prosthetic heart valves.

level signals, and provides an antialiasing filter before sending the voltage levels to the DAQ boards.

Two 50-conductor ribbon cables connect the interface to the AT-MIO-16F boards. Using a single LabVIEW virtual instrument (VI), we can turn on the sensor interface, adjust the strain-gauge offsets, move the cutoff frequency of a programmable highpass filter, and adjust the ventricular volume so we can study the effects of heart size.


Satisfied with the adjustments, we measure six signals during a typical test:

- Strain on the valve inlet strut
- Strain on the valve outlet strut
- Valve occluder position
- Pump piston position
- Left ventricular pressure (LVP)
- Ventricular acoustic signal

The acoustic signal is sampled at 100 ksamples per second (kS/s) by the first AT-MIO-16F. The other five signals are sampled at 40 kS/s by the second board.

A digital trigger generated by the 386 PC paces the data acquisition. This PC

executes a waveform editor written in C++ with which we can generate a digital trigger at any point during the heartbeat. Usually, there is one trigger per heartbeat placed about 20 ms before the valve closes.

We are very pleased with our decision to use LabVIEW for Windows. It is a rich programming environment with excellent product support and documentation. The combination of LabVIEW for Windows and National Instruments hardware has performed very well for us. 

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