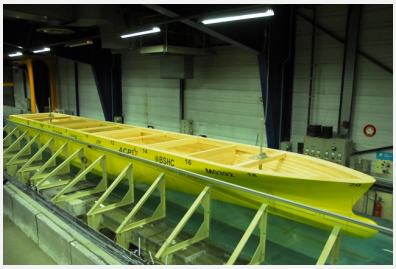
LabVIEW and PXI Help Validate the Hydraulic Systems of the Future Panama Canal Locks



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- Frédéric Bégeot, CNR

The Challenge:
Validating the filling and emptying system of the future Panama Canal locks on a 1:30 scale physical model.

The Solution:
Developing a system that consists of a host PC, a PXI chassis with a real-time controller, and motion control and data acquisition devices – all powered by software developed using NI LabVIEW.

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At the CNR hydraulic laboratory of test and materials, the Panama Canal project consists of implementation of a physical model to study the upcoming Panama Canal locks using a 1:30 scale model of the canal that is 65 m long and 13 m wide.

The main purpose of the study using the physical model was to validate the lock filling and emptying system provided after a six-year study based on a digital model that simulated the various filling and emptying operation scenarios. It included almost 100 sensors and more than 1,000 tests have been conducted within seven months.

Managing the Lock Actuators and Nearly 100 Sensors

In the laboratory, we had the ability to acquire about 30 channels on a data logger; however, because we could not automatically drive the components of the locks, we had to find a solution that addressed this need.

We had to manage and represent the lock's opening and closing components as well as the real lock. We also had to simultaneously acquire data from about 100 sensors; therefore, we needed a solution to accurately drive the components while acquiring data in real time. In addition, we had to meet the exact deadlines required by the specifications of our customer, the Panama Canal Authority (ACP).

A Solution Based on a Real-Time PXI Controller

The company we chose to work with had four months to set up the program-chassis combination.

The software, developed in LabVIEW, was built on two microcomputers, a desktop PC host for the human-machine interface and an industrial PC, a controller module embedded in a PXI chassis that provides all the basic functions between the host PC, and the various sensors and actuators on the model. The PXI chassis is enclosed in a rack, which also includes eight drawers.

This hardware and software combination provides data acquisition from 87 sensors, visualization of these measurement changes on the host PC display, data storage in different files, and control of the opening and closing of 24 valves, both manually and sequentially, using test cases.

The PXI rack drawer consists of five modules inserted into the chassis. The NI PXI-8184 real-time controller receives the LabVIEW Real-Time application, is designed to operate autonomously, and communicates with the supervisor (host PC) via its Ethernet link. The NI PXI-6513 digital I/O module, which includes 64 sinking outputs, has programmable power-up states and outputs that are optoisolated per an 8-channel bank. The input voltage range is ± 30 V and the maximum sink current reaches 125 mA per channel.

Other PXI modules used in the application include the following:

- An NI PXI-6723 module, which includes 32 13-bit analog outputs and has eight digital I/O lines and two 24-bit counter/timers
- An NI PXI-6225 analog input multifunction data acquisition module, which includes 80 16-bit analog inputs, 24 digital TTL I/O lines, two 32-bit counters, and two 16-bit analog outputs.
- An NI PXI-6220 module, which includes 16 16-bit analog inputs, 24 digital TTL I/O, and two 32-bit counters

Benefits and Outlook

The NI solution featured a cost benefit in comparison to other options as well as the ability to insert signal isolators to prevent ground loops, which was beneficial because in the past we experienced some noise that disturbed our output signals. Also, contact with the integrator was vital.

The test results helped define the hydraulic performance of the lock power supply system and validate the specification basis for the structure based on hydraulic aspects. We are currently building a second model for the Panama Canal locks. The LabVIEW program will evolve and the sensor types will change as well as some components for opening and closing management; however, we will not make any hardware changes or use additional sensors.

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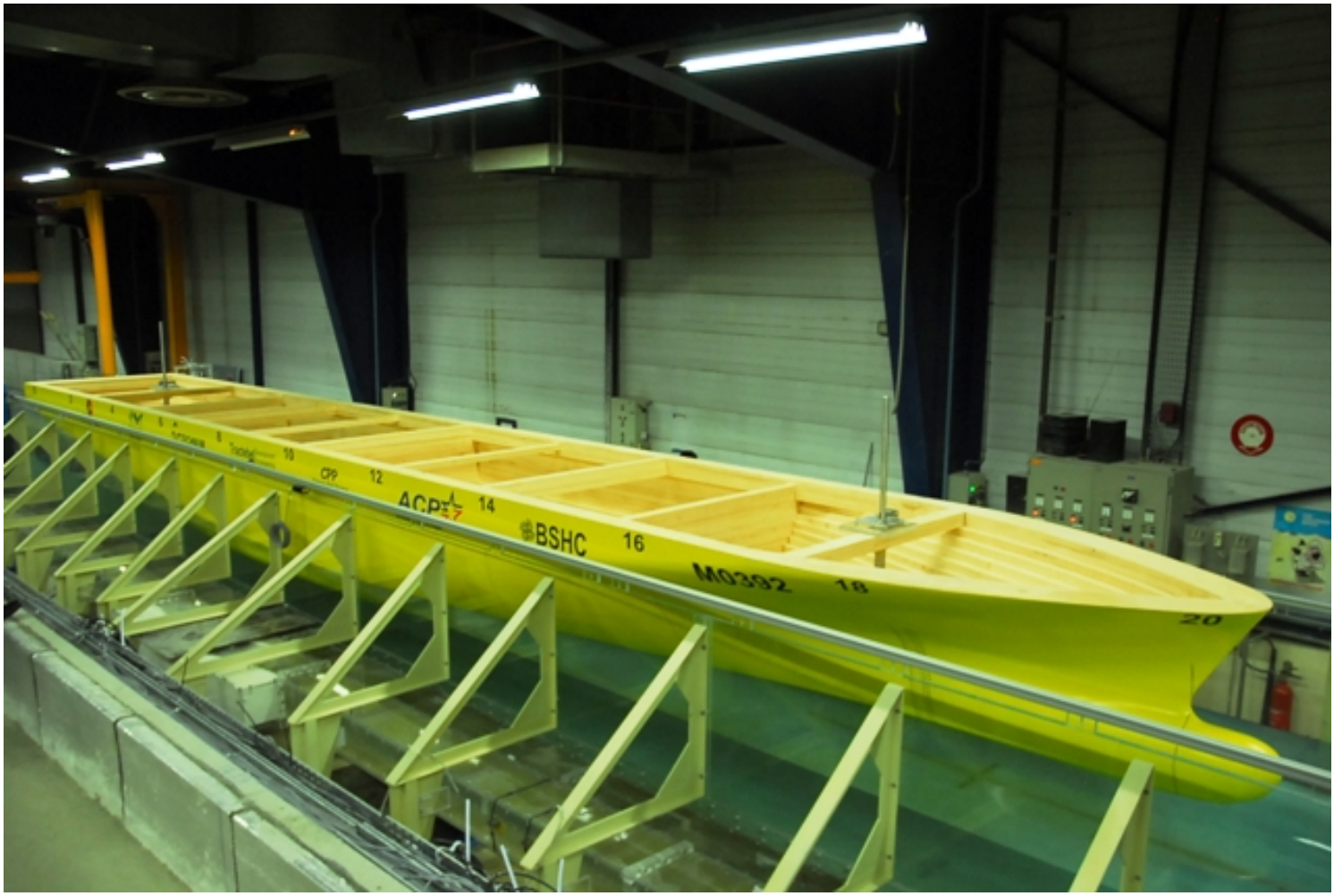

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