Project: Marine Industry

industrial systems and control

Control Software Development for Motion Stabilised Gangway (Turbine Access System)

From Concept to Deployed System

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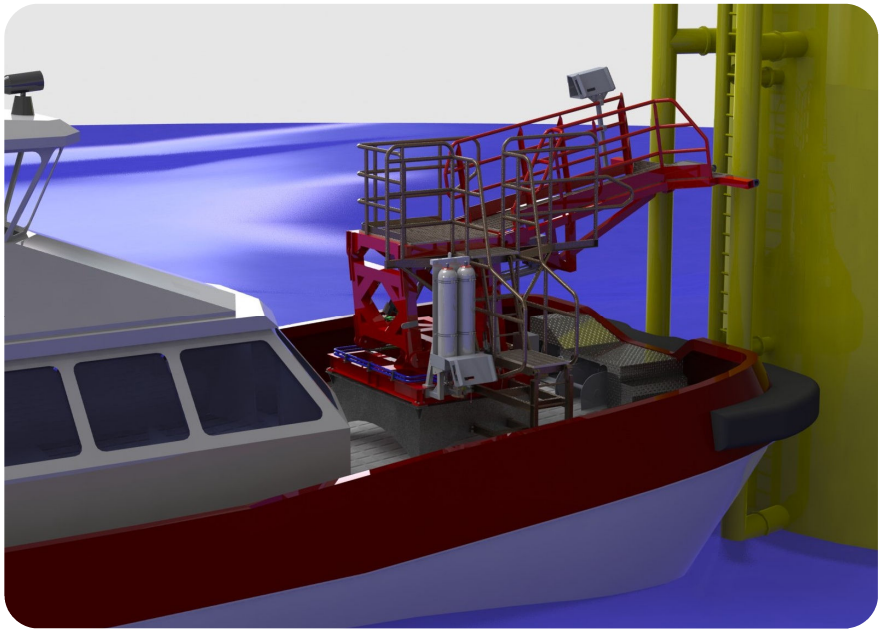

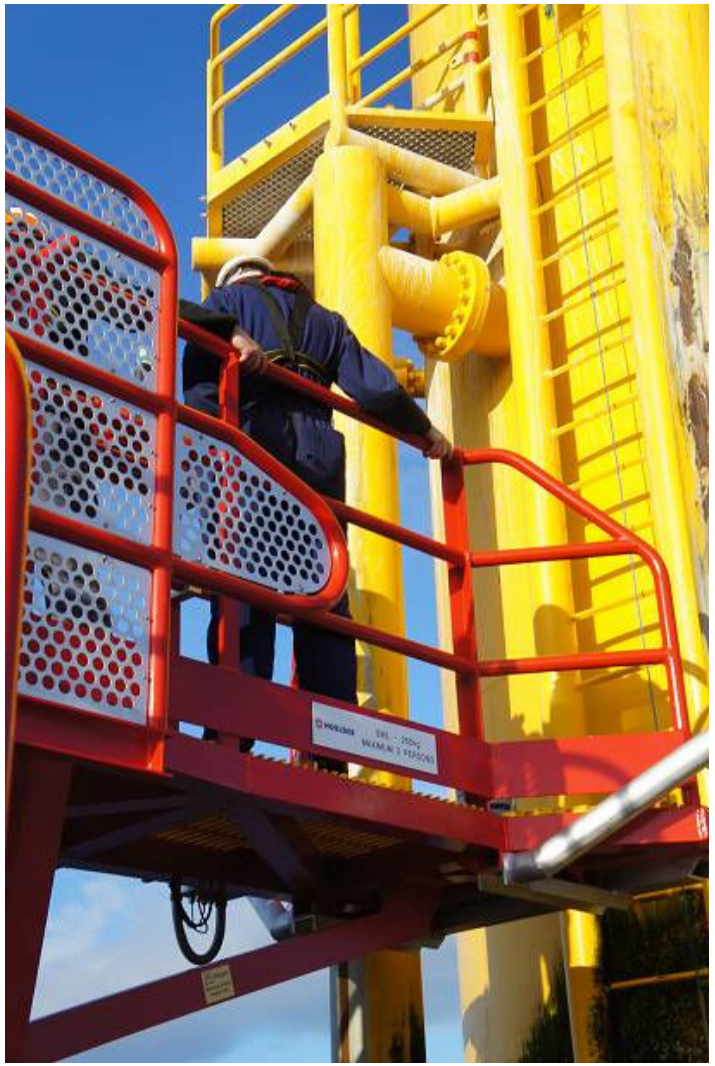

The Problem

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- Offshore wind increasingly important, but economic challenges:
  - Install + grid connection
  - Through life maintenance costs
- Transferring personnel from boats to wind turbines currently done using “friction lock”
  - Small, light boats – transfers restricted by weather / sea state
  - Risky – even in calm seas, can get occasional big wave
- Even more important for bigger, further offshore wind farms

The Concept

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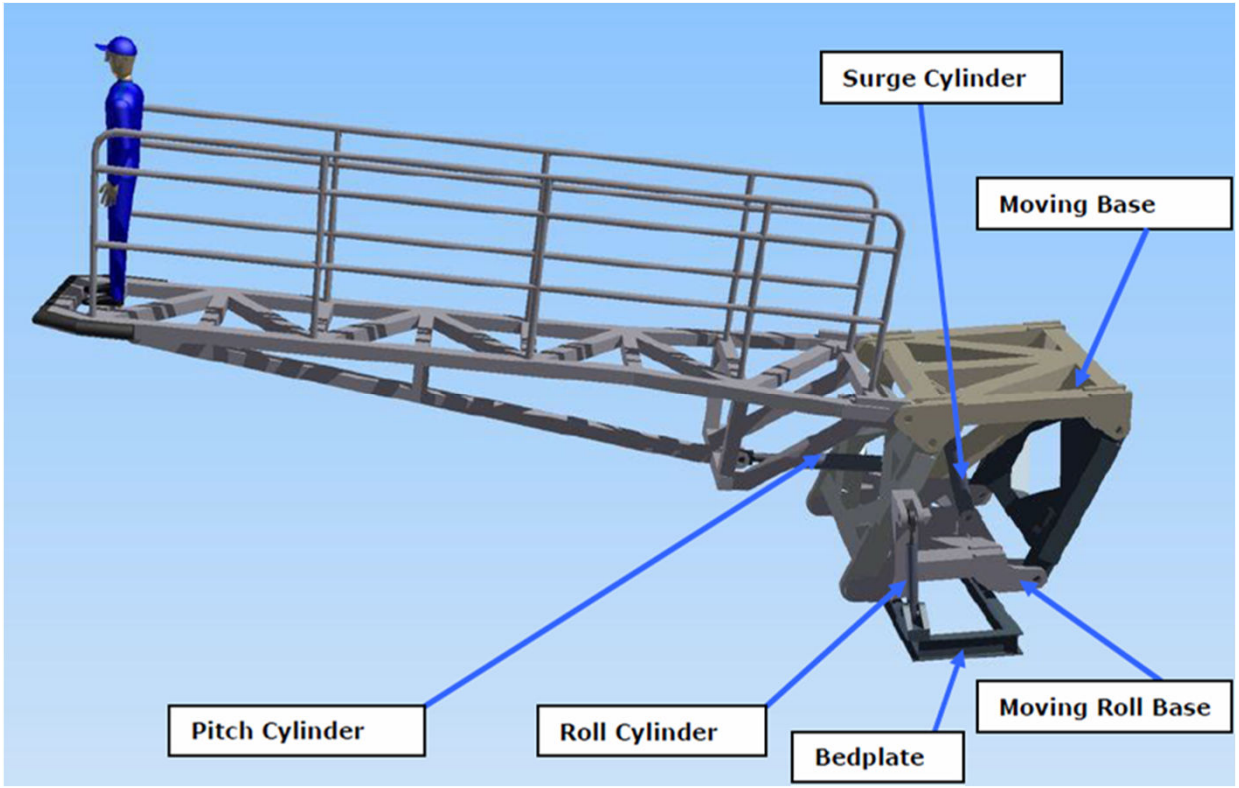
- Houlder developed Turbine Access System (TAS) concept
  - Hydraulic gangway to compensate for vessel heave, pitch and roll
  - Not in contact with tower - important



Control System Development

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- ISC engaged as subcontractor for control system design
- Initial simulation phase to assess achievable performance
- Implementation in LabVIEW:
  - Emulator built to allow office-based testing – helped greatly
  - Inverse kinematics – used Mathscript nodes
- In factory – core functionality “worked” first time !!
- But took much testing to perfect everything:
  - Control – refining scheme, tuning, validating kinematics and MRU, synchronisation of loops and IO (very important)
  - Operational logic / monitoring – fully tested against faults

The Real System

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The Control System

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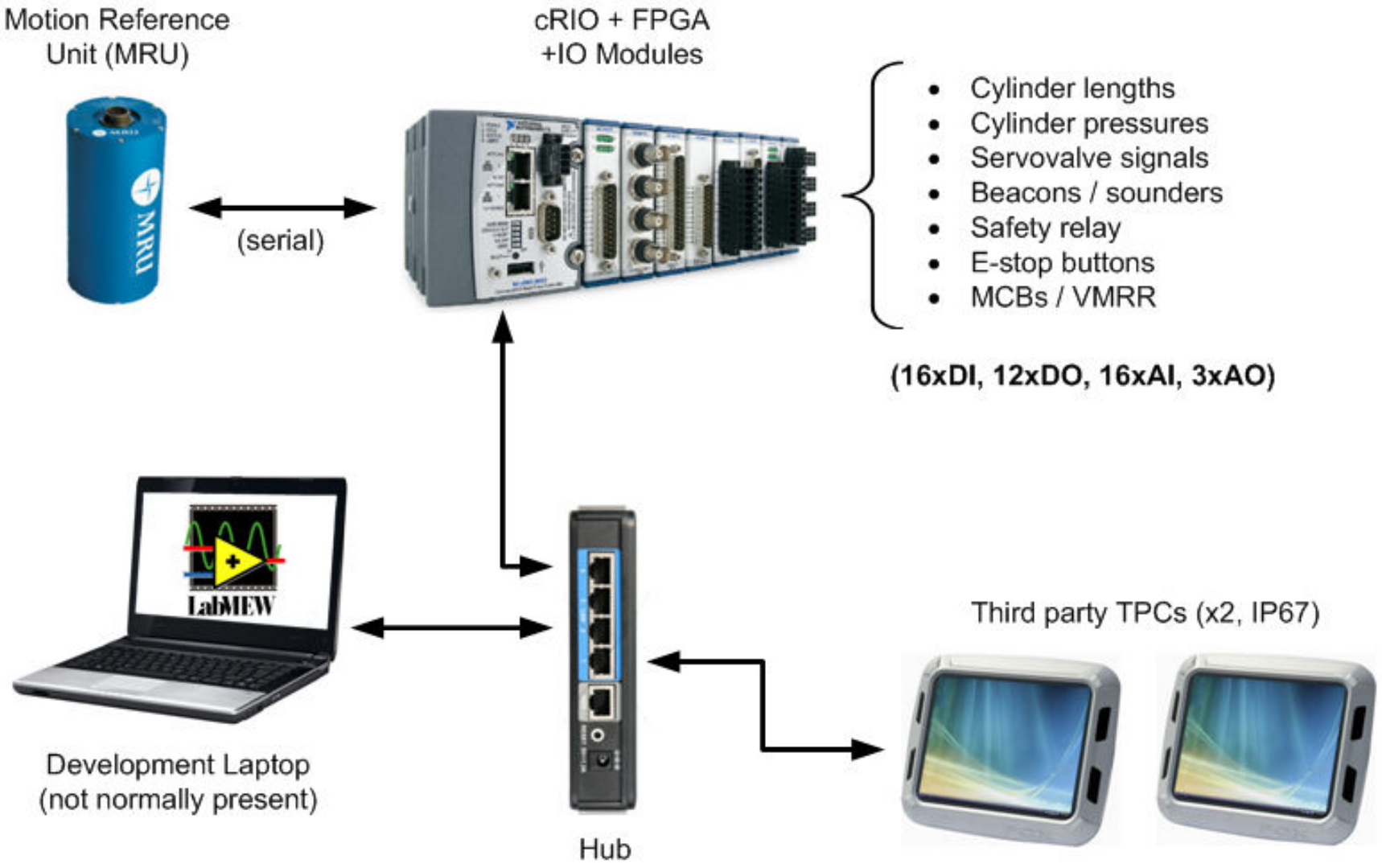

The Control System

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- NI CompactRIO Controller runs:
  - Inverse kinematics – LabVIEW Mathscript RT
  - Real time control – cascaded controllers with feedforward and nonlinear compensation
  - Interfacing to MRU and safety system
  - Operational logic – state machine to handle different modes
  - Monitoring / Fault Actions – extensive, changes with operating mode
- FPGA watchdog independent of cRIO – initiates emergency stop
- TPCs – user interface for operating TAS, alarms and configuration
  - Many different screens; via shared variables

Inverse Kinematic Transformations in Mathscript RT Nodes

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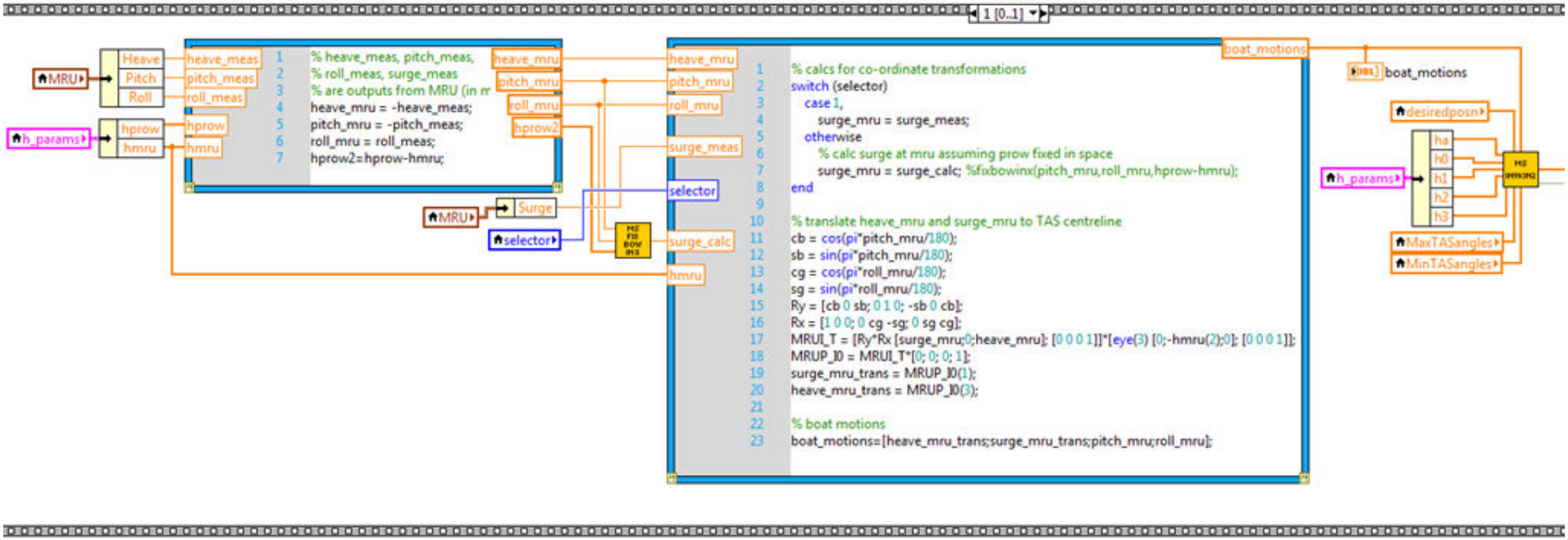

Everything built in LabVIEW: Real-Time, FPGA, Mathscript RT, TouchPanel Module

Progress

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- Fully working – many online videos
  - http://www.youtube.com/watch?v=N21en93lrqg
- Customer acceptance testing / approval by Lloyds Register
- NI user Case Study which won awards UK and internationally*
- Sea Trials – Sept 2012
  - Tested in open water and then on RWE's Rhyl Flats wind farm
  - Performance good – controllers / MRU retuned for actual motions
- Boat now being fitted with rollers on bow and in operation

* *1) GSDA Awards UK Application of the Year* and *Advanced Control Systems Winner NI Days 2012*

2) GSDA Awards Worldwide Application of the Year and Advanced Control Systems at NI Week 2013

Sea Trials – Sept 2012

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Sea Trials – Sept 2012

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