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EXCELLING LABUST IN MARINE ROBOTICS

Control of Marine Craft

CONTROL SYSTEM

Edin Omerdic

Senior Research Fellow

Mobile & Marine Robotics Research Centre

University of Limerick

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 691980.

Outline

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- Control System
  - General Control Objectives
    - Setpoint Regulation
    - Trajectory-Tracking Control
    - Path Following Control
  - Low Level Controllers (LLC)
    - Architecture
    - Implementation
    - Autotuning
  - Middle Level Controllers (MLC)
    - Description
    - Implementation
    - Examples

GNC Signal Flow

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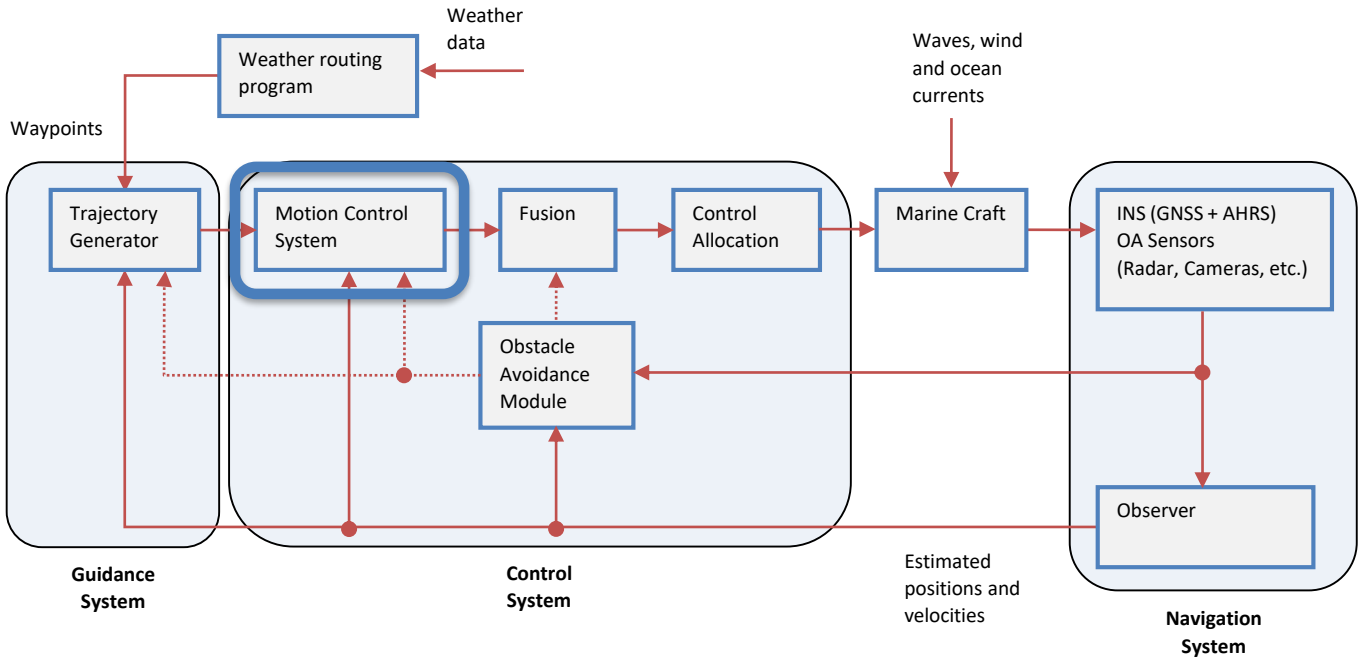
GNC Signal Flow



Setpoint Regulation

- Constant input (setpoint) provided by a human operator.
- Corresponding controller ≡ **Regulator**.
- Examples:
    - constant depth,
    - constant altitude,
    - constant speed.

Trajectory-Tracking Control

- The position and velocity of the marine craft are tracking desired time-varying position and velocity reference signals.
- Corresponding controller ≡ **Trajectory-Tracking Controller**.
- Examples:
    - course-changing maneuvers,
    - speed-changing maneuvers,
    - attitude control.

Path-Following Control

- Marine craft follows predefined path independent of time.
- Examples:
    - ship in transit between continents,
    - underwater vehicles mapping the seabed.

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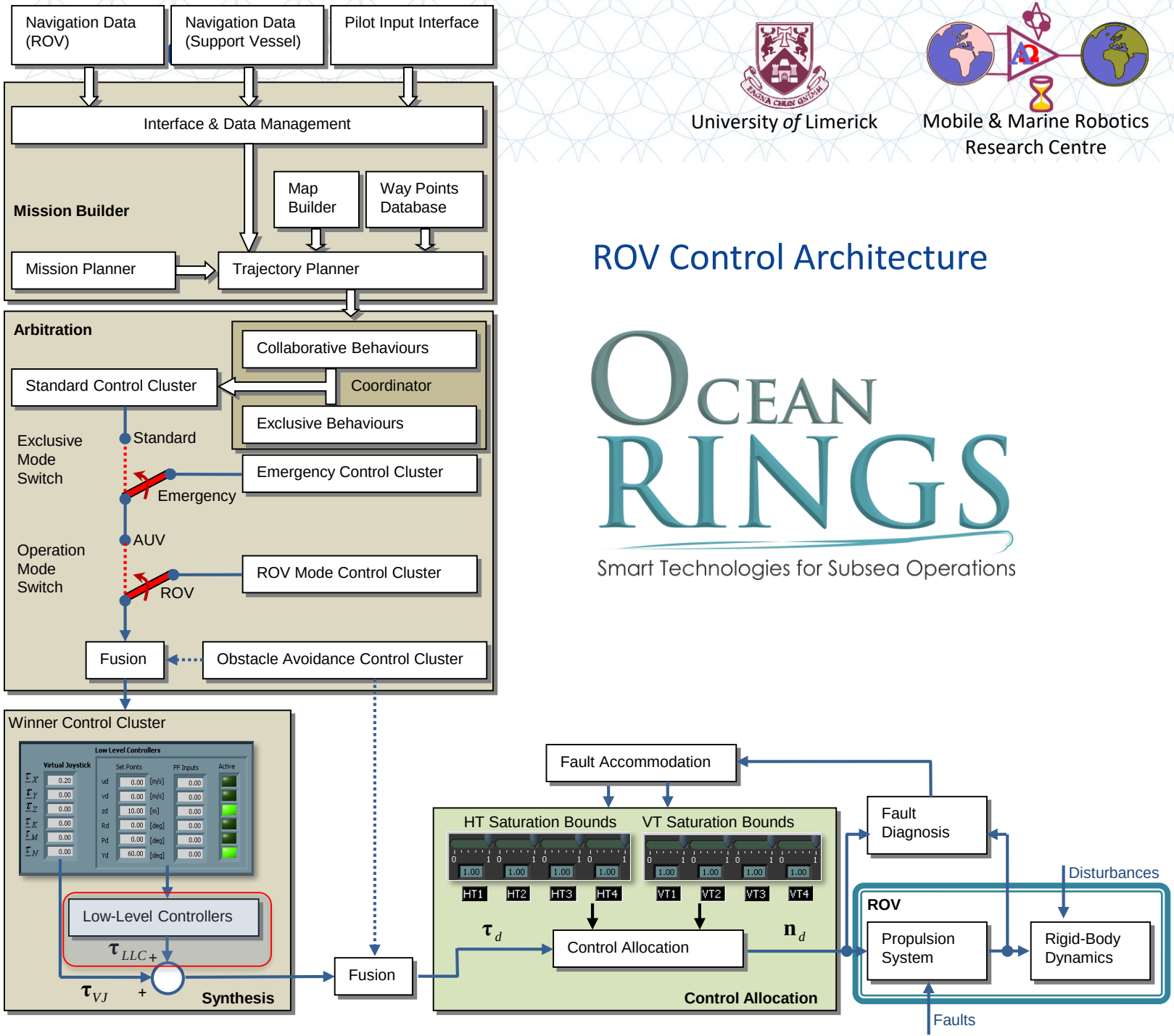
ROV Control Architecture

OCEAN RINGS

Smart Technologies for Subsea Operations



Control System

Low Level Controllers (LLC)

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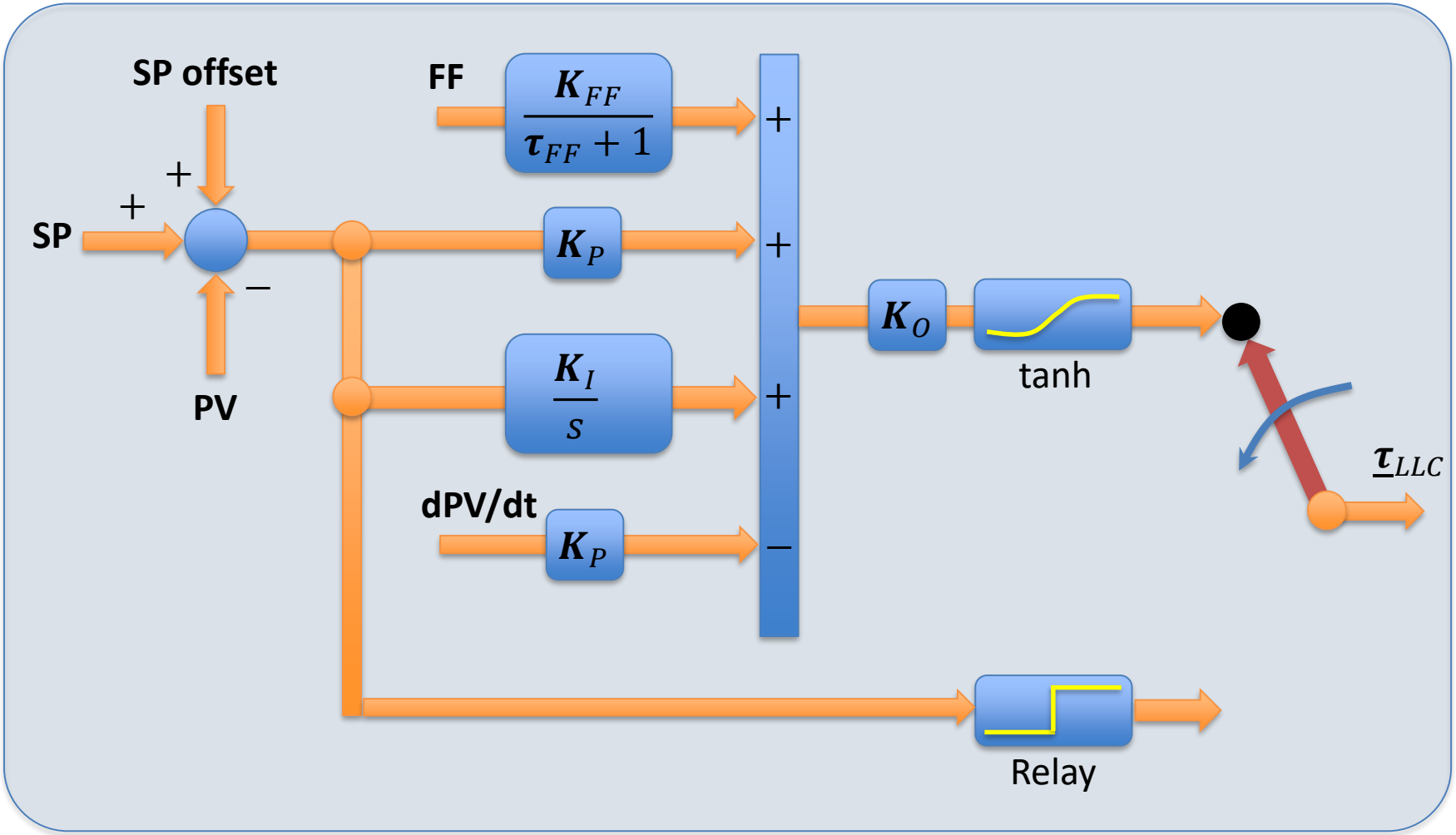
Architecture



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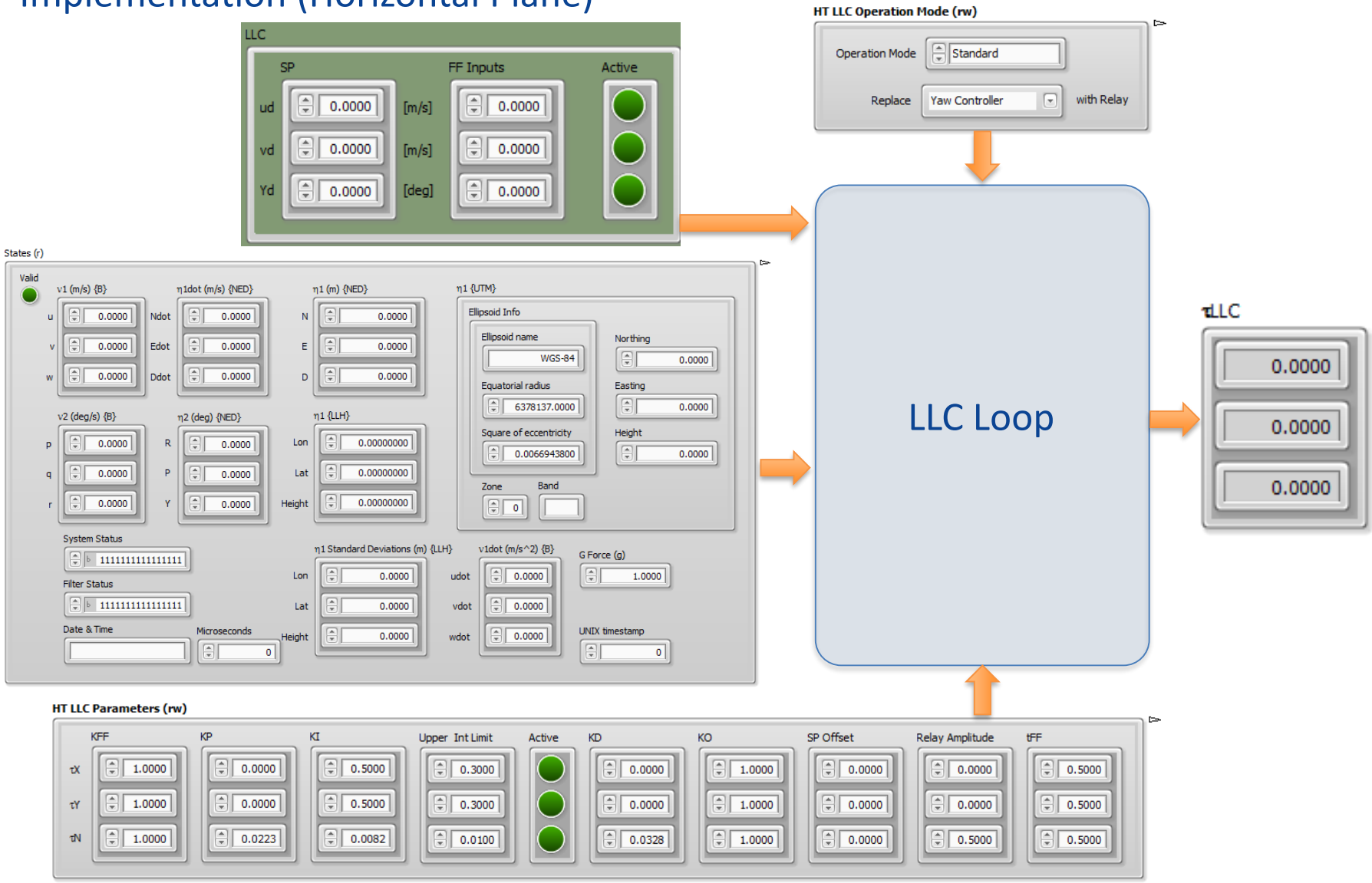
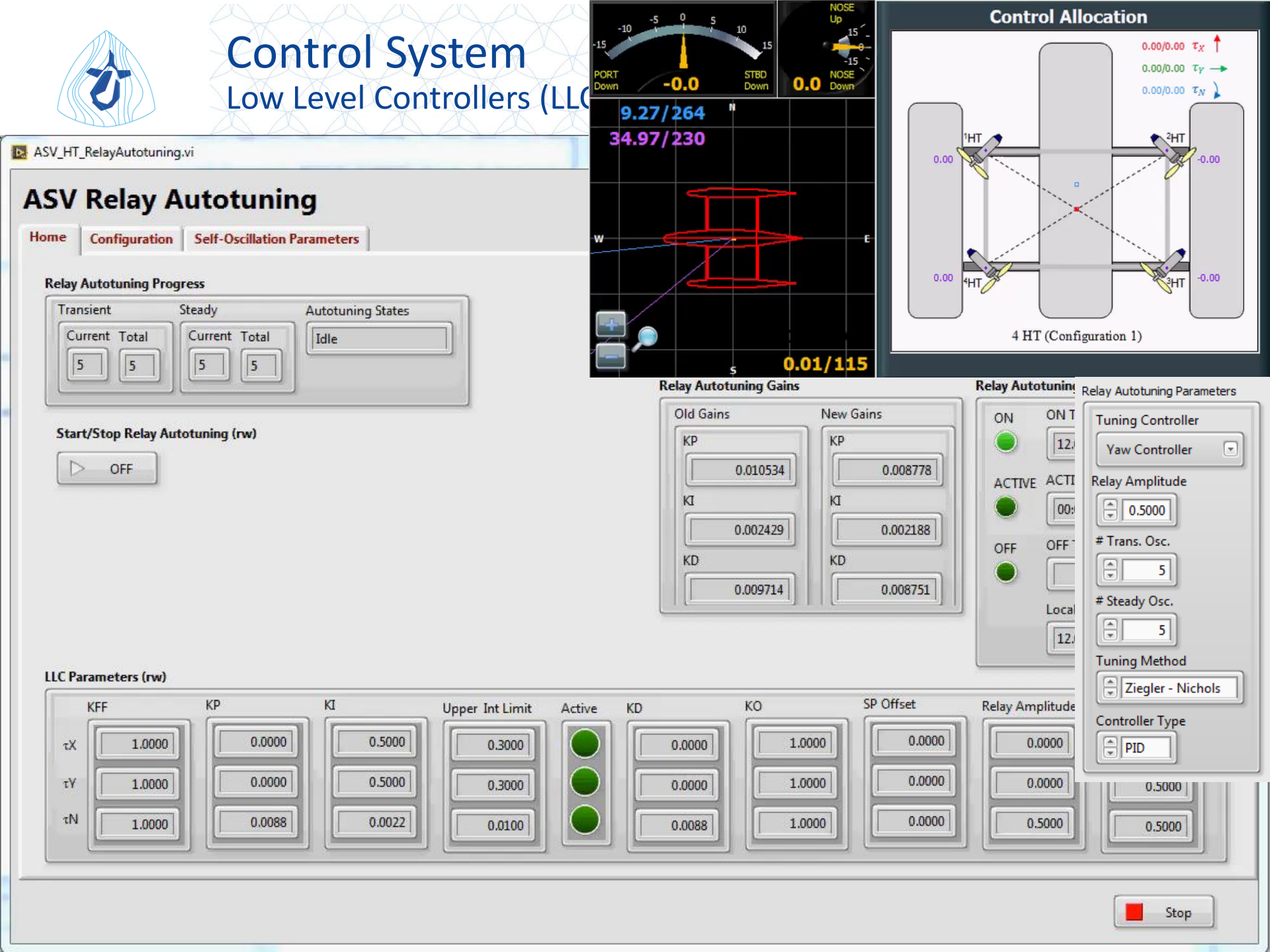
Implementation (Horizontal Plane)



Control System

Low Level Controllers (LLC



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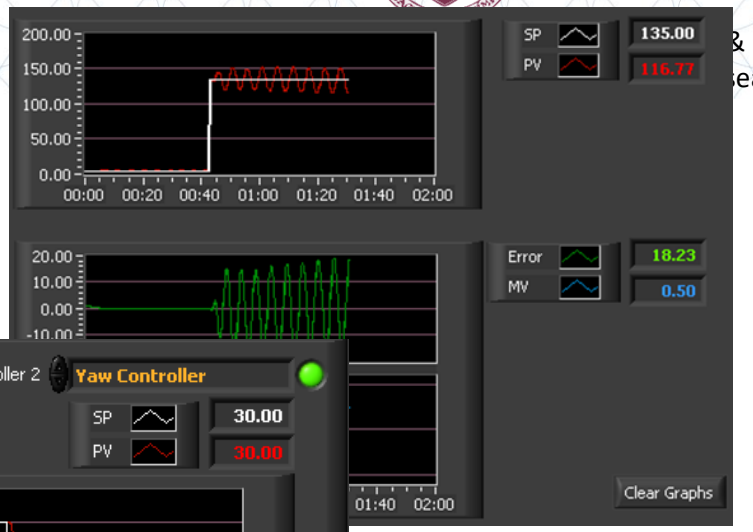
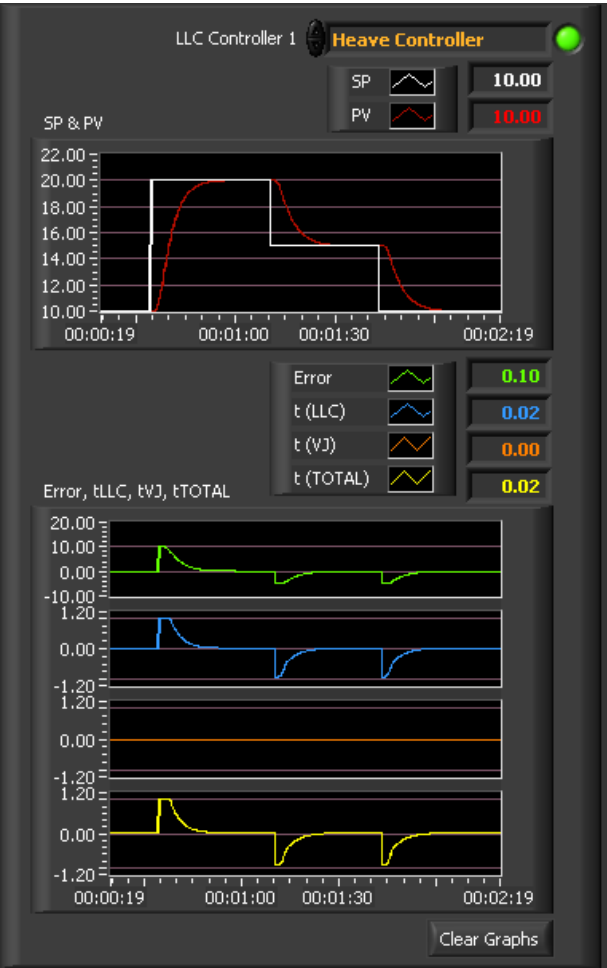
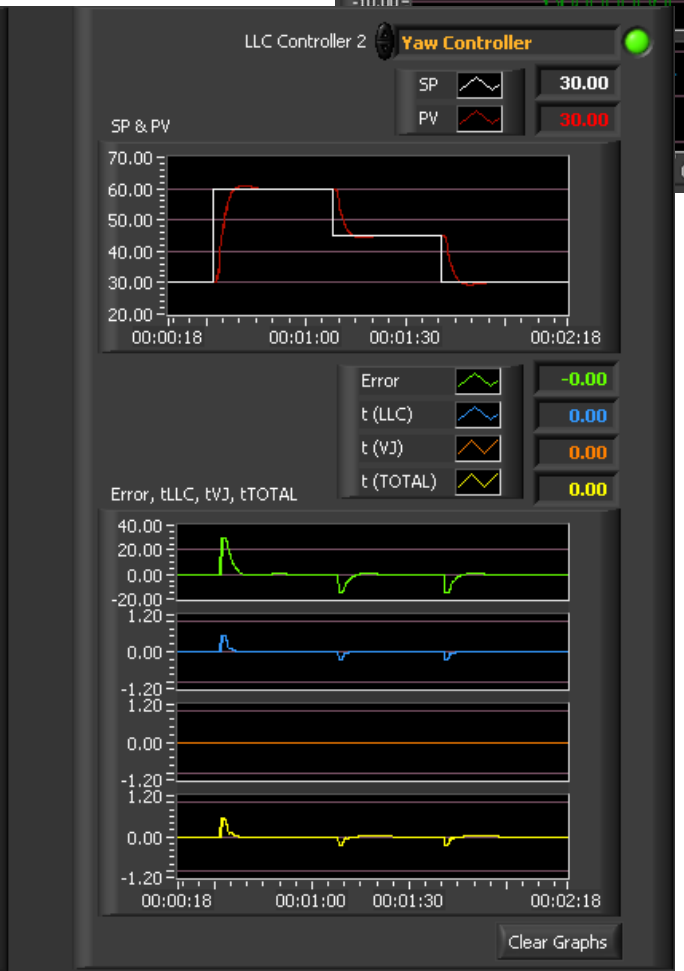
Autotuning (ROV LATIS)



ROV performs self-oscillations during autotuning





After autotuning both controllers demonstrate excellent performance, regardless of cross-coupling effects

Control Sy
Low Level Con

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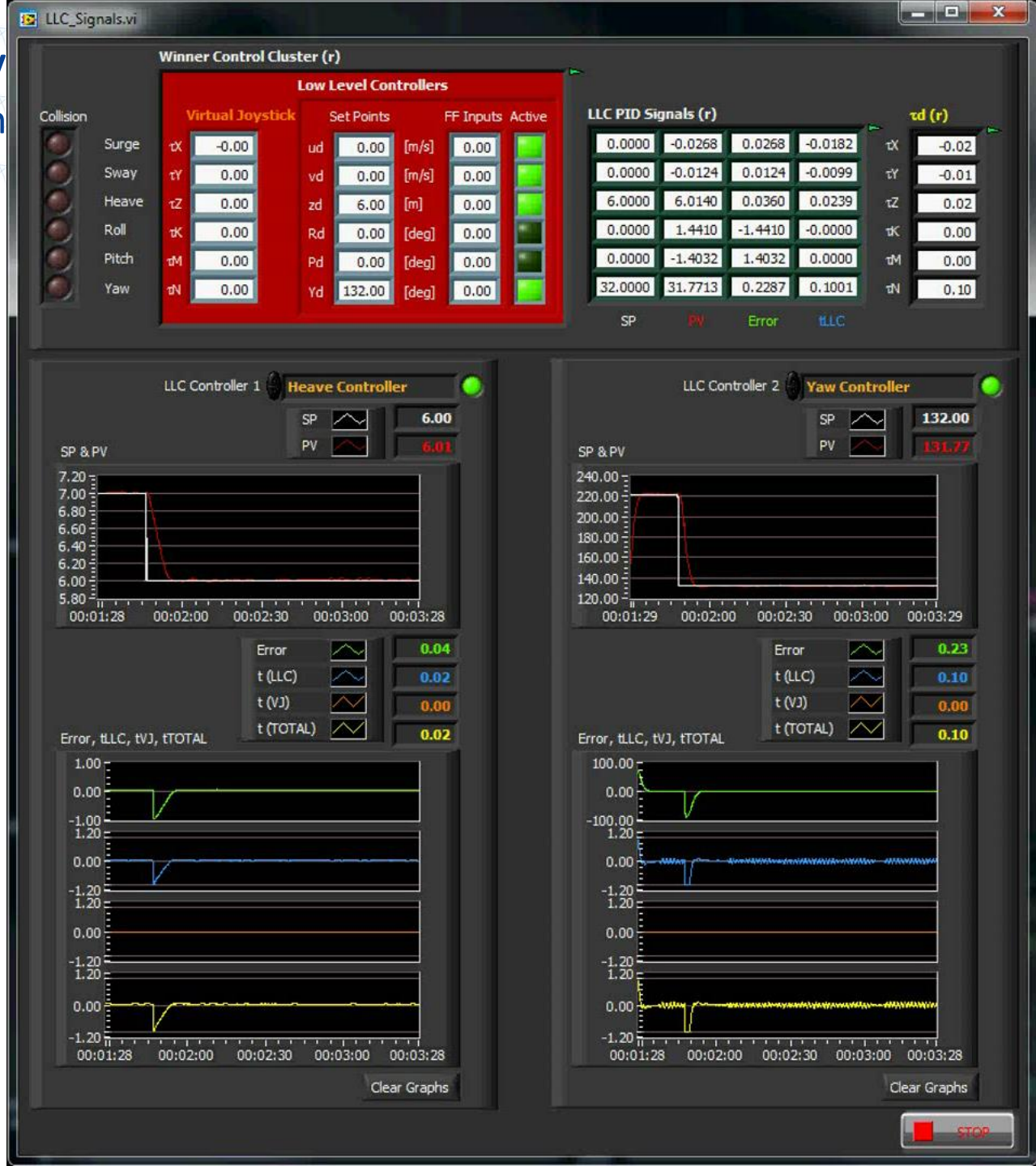
Cruise: ANT 2012 (Part 2)

Date: Oct 2012

Location: La Spezia, Italy

ROV: LATIS

Ship: CRV Leonardo



Performance of Depth controller (left) and Heading controller (right) after autotuning

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Middle Level Controllers (MLC)

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Heading Controller	
Type:	Position Controller
Output:	Y_d
Inputs:	User Setpoint, Desired Course, Fixed Point, System States
Heading Modes:	HM1: Independent HM2: Follow Course HM3: Fixed Point HM4: Relative to Course HM5: Follow Ref. Frame

Speed Controller	
Type:	Velocity Controller
Output:	u_d, v_d
Inputs:	User Setpoints, Absolute Target, Relative Target, System States
Speed Modes:	SM1: Manual Surge & Sway SM2: Speed & Course Controller SM3: Hold Position SM4: Go To Position
Tracking Modes:	TM1: Follow Absolute Target TM2: Follow Relative Target
Target Actions:	TA1: Hold Absolute Position TA2: Hold Relative Position TA3: Go To Absolute Target TA4: Go To Relative Target

Horizontal Plane

Contr
Middle

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Heading Controller
HM1: Independent

Speed Controller
Not Active

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Contr
Middle

Heading Controller
HM2: Follow Course

Speed Controller
SM2: Speed & Course Controller

Cont
Middle

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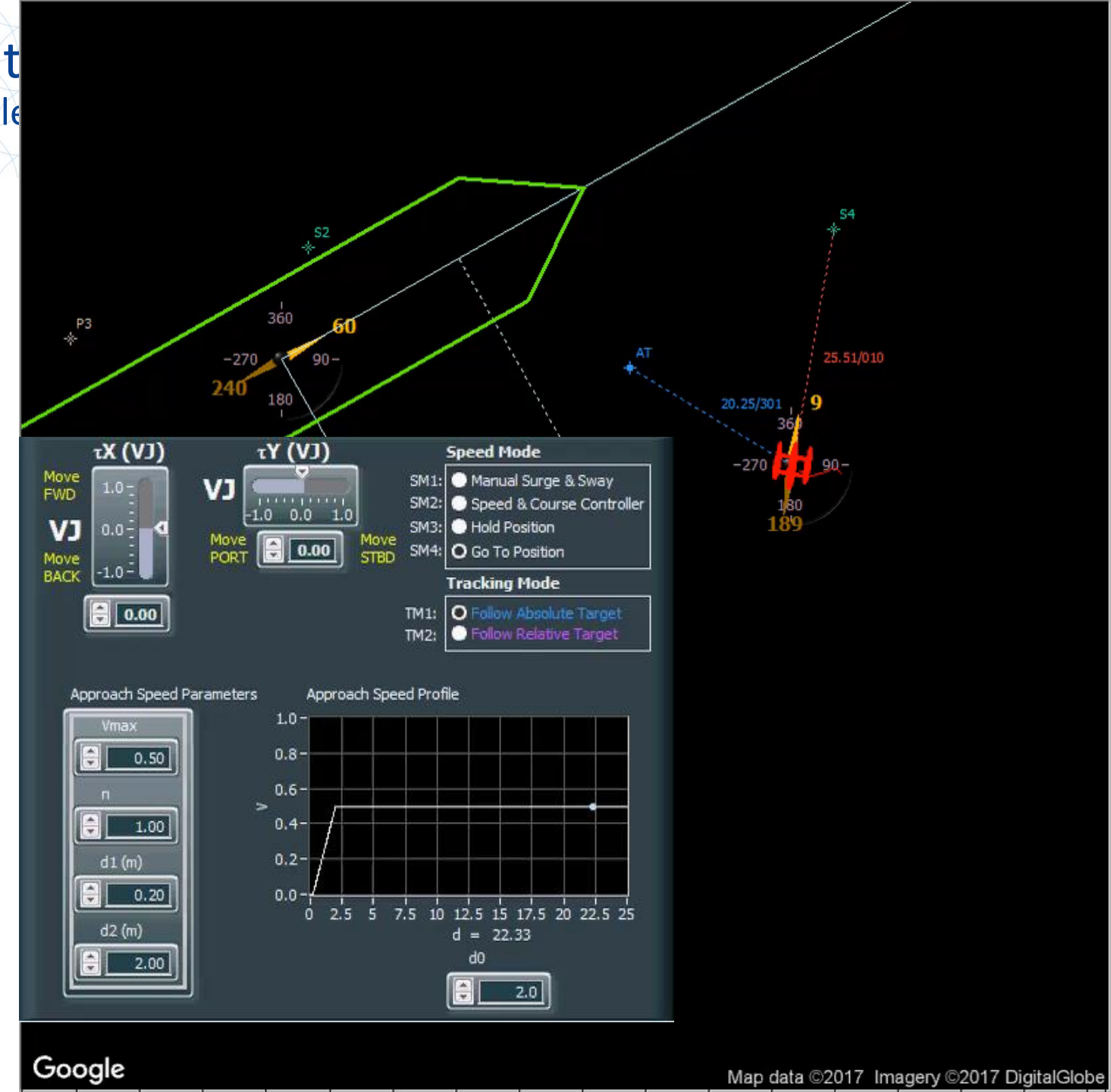
Heading Controller

HM3: Fixed Point (S4)

Speed Controller

TA3: Go To Absolute Target



Heading Controller

HM4: Relative to Course

Speed Controller

SM2: Go To Absolute Target

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UNIVERSITY OF ZAGREB FACULTY OF ELECTRICAL ENGINEERING AND COMPUTING

LABUST LABORATORY FOR UNDERWATER SYSTEMS AND TECHNOLOGIES

Consiglio Nazionale delle Ricerche

UNIVERSITY of LIMERICK OLLSCOIL LUIMNIGH

Universitat de Girona Institut de Recerca en Visió per Computador i Robòtica

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