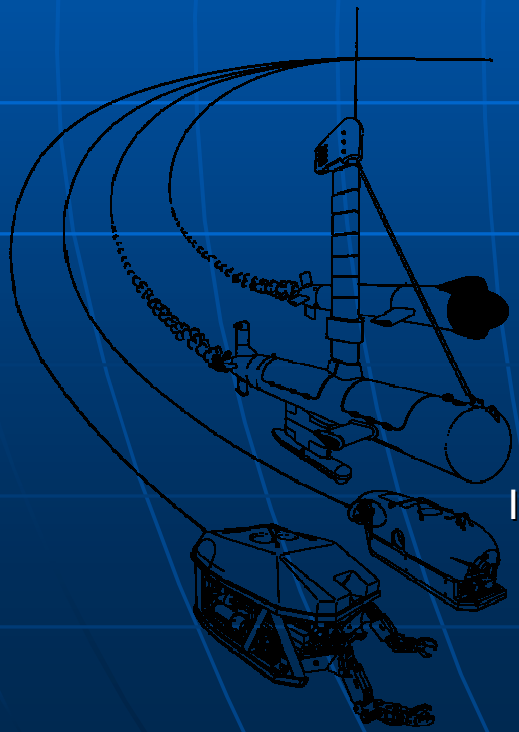
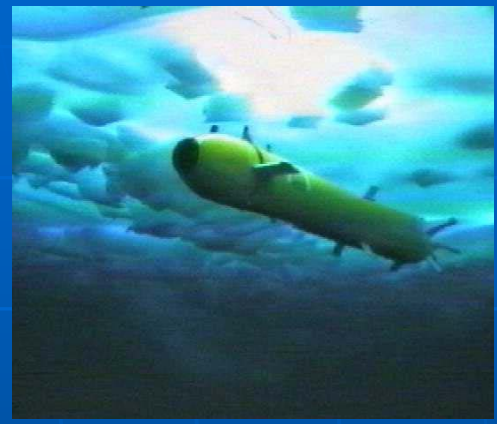
ISE’s Common Control System



International Submarine Engineering (ISE) Ltd.

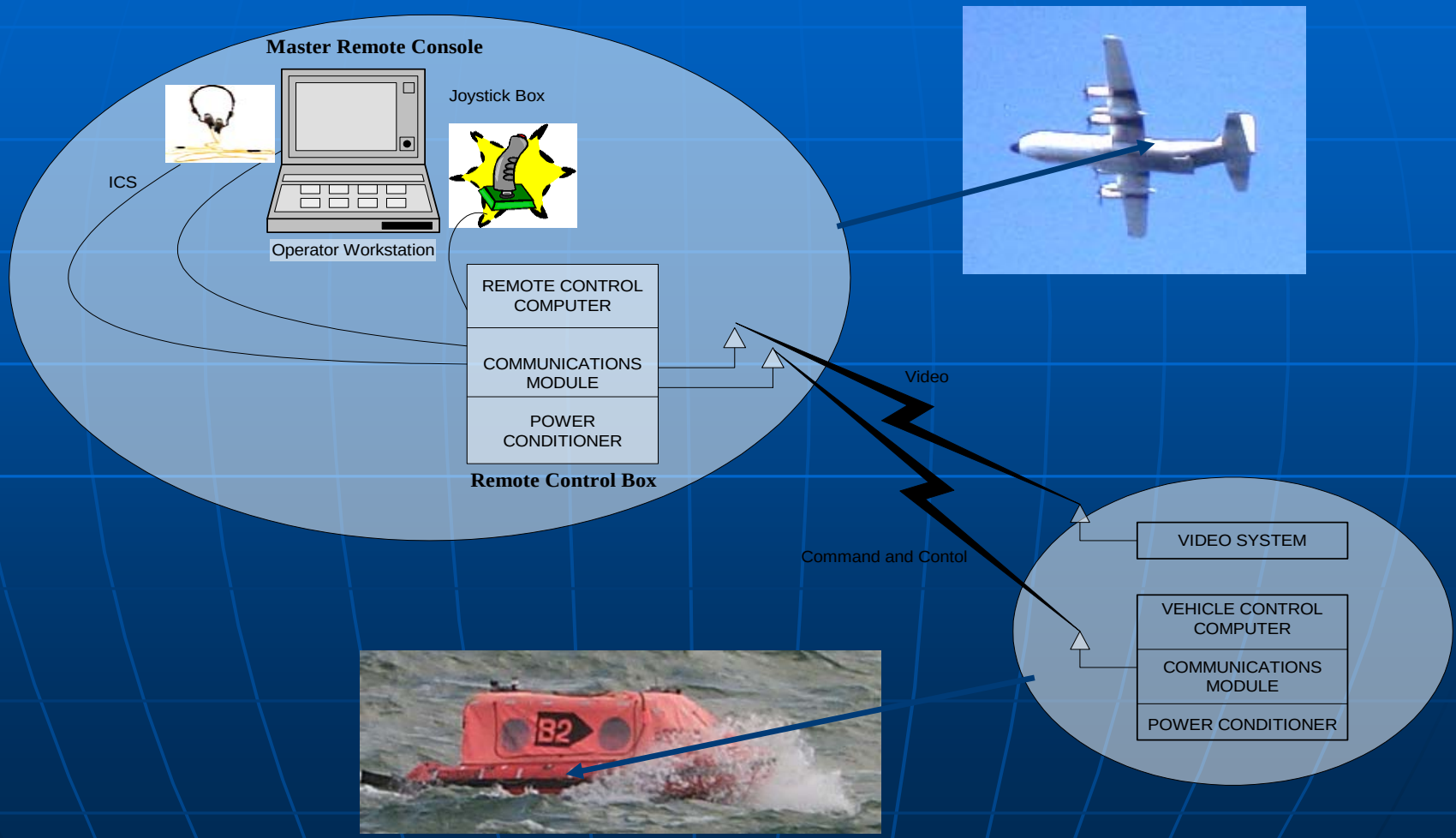
A Diversity of Mobile Platforms



Strategy- Re-use existing, proven technologies
- Integrate them into modular mobile platforms
- Configured to fit specified mission requirements.

All with commonality in the control system.

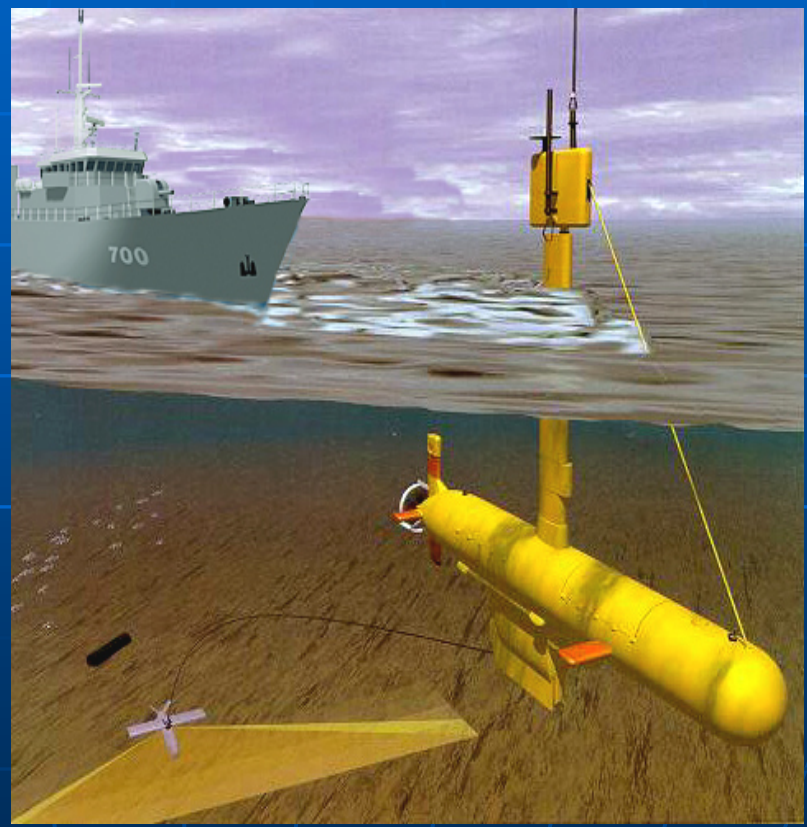
USV Command & Control



Control System Design Considerations

Electrical / Mechanical Interfaces

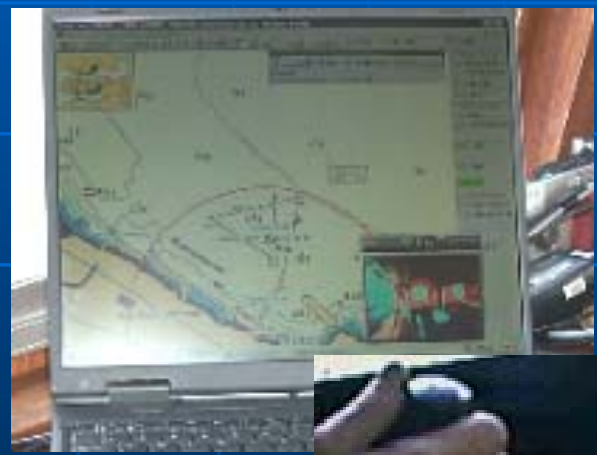
- Sensors
- Actuators
- Power Distribution
- Communications



Control System Design Considerations

Operator Interfaces

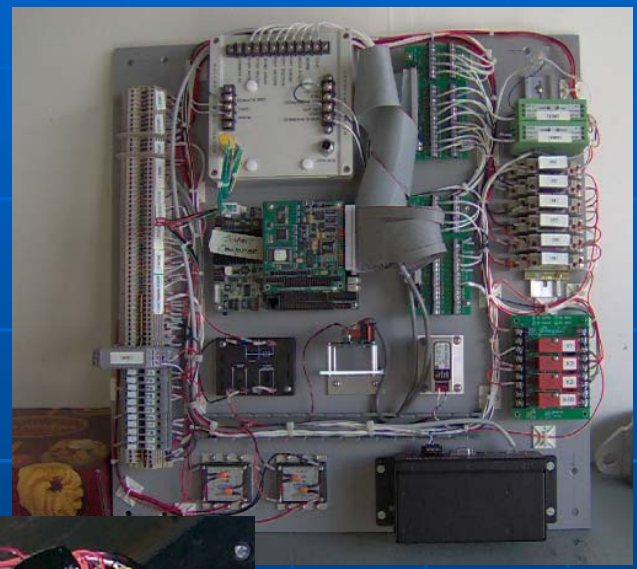
- Joysticks
- Buttons/Lights
- Displays
- Video Systems
- Audio

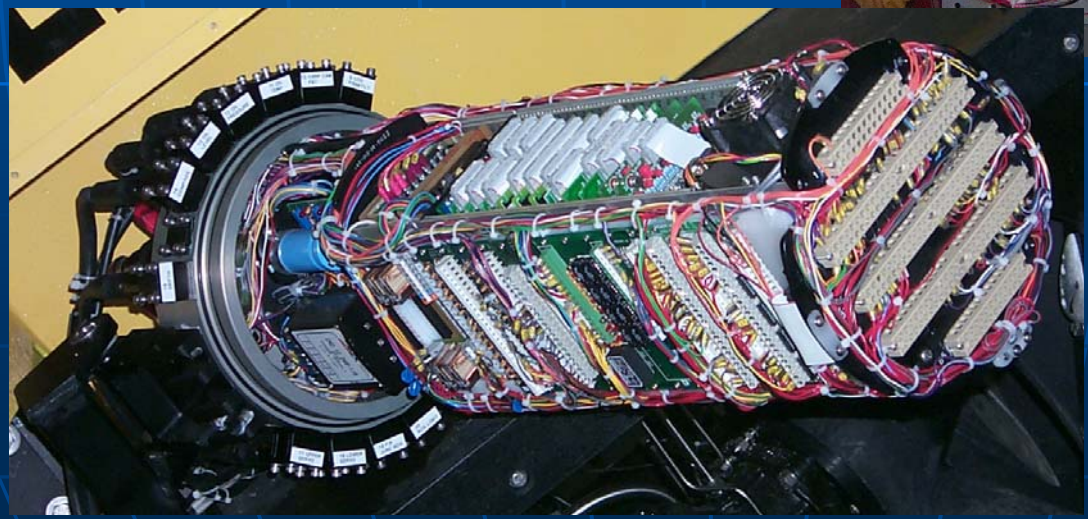


Control System Design Considerations

Computers

- Form factor (eg. cPCI)
- Processor
- Input and Output Distribution
- Electrical Terminations & Signal Conditioning





Control System Design Considerations

Operator Interfaces

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- Buttons/Lights
- Video Systems
- Audio

Electrical / Mechanical Interfaces

- Sensors
- Actuators

Computers

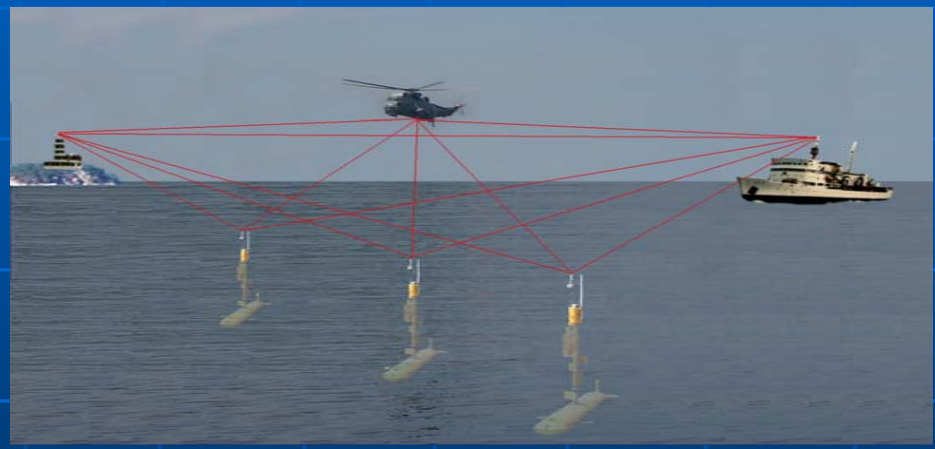
- Form factor (eg. cPCI)
- Processor
- Input and Output Distribution
- Electrical Terminations & Signal Conditioning

Software

- Operating System
- Graphical User Interfaces
- Control Software

Common Software Components

- Sensor Interfaces & I/O
- Positioning & Navigation
- Autofunctions – Autoheading, Cruise, Stationkeeping
- Waypoint & Route Following
- Mission Planner & Scripts
- Communications & Telemetry
- Multi-vehicle Operations
- Transfer of Control
- Operator Interface



AUV Payload Integrations

- Loran C Navigation
- Elac Single Beam Echo Sounder (2)
- Syledis Positioning system
- NRL Custom Payload
- Ametek Straza DVL
- Robertson SKR 80 series Gyrocompass (2)
- Mesotech 1007 Obstacle Avoidance Sonar
- Oceano Long Baseline System
- Collins AN/ARC 182 Data Radio
- Klein 595 Side Scan Sonar
- Metratek Forward Looking Sonar
- Nautronix SBL Positioning System
- UV High Bandwidth Acoustic Comms
- Polarfix Laser Positioning System
- Simrad EM950 and 1000 Multibeam Echosounder (2)
- DRDC Motion Recording Pack (2)
- Simrad 992 Sidescan Sonar
- DataRadio 450KHz modem
- Novatech RF Beacon
- Novatech Emergency Strobe
- ORE Trackpoint II USBL
- ORE LXT USBL
- Honeywell 726 MAPS INU
- EDO Western 3050 DVL
- FCT 60 and 100 KWh fuel cell (2)
- Fibre-optic cable integrations (3)
- ORE Homing System
- Datasonics Communications and Pos'n Systems (2)
- Watson AHRS – various models
- Seabird SBE Conductivity, Temperature Depth (3)
- Imagenex Multibeam (Delta T)
- AN/AQS 14 Sidescan Sonar
- DRDC experimental Klein Sidescan Sonar
- Reson 8101 Multibeam Echosounder
- C-Span High Bandwidth Data Radio
- Klein 5500 Multibeam Sidescan Sonar
- Rockwell Collins Quartz Rate C-Migits INU
- RDI DVL and ADCP (3)
- AMS Mass Spectrometer
- AMS Conductivity, Temperature Depth
- GPS – various including Thales, Motorola, SOS
- IxSea PHINS INU (2)
- Kongsberg Mesotech 1007 Altimeter (3)
- Kearfott 6053 SEADeVil INU
- Sercel Orca MATS 200 Acoustic Telemetry
- Datalinc RF modem 900 and 2400 MHz (3)
- Video Cameras (2)
- Wilan RF data Modems – 3.5 and 5.8 GHz (2)
- Kongsberg Simrad EM 2000 Multibeam Echosounder
- LinkQuest UWM series Acoustic Telemetry (2)
- Kongsberg Simrad EK60 Fish Stock sonar
- NAL Iridium modem
- Reson 7125 Multibeam Echosounder
- IxSea Posodonia LBL\USBL
- Fluorometer
- DSTL custom payload
- Motorola RF data modem
- IxSea Synthetic Aperture Sonar

Software Development Costs $$$

So

1. New software development must be minimized
2. Existing software must be leveraged

How?

1. Systems approach
2. Open Architecture
3. Code reuse by modular design

System Design Approach

- ISE takes a “Systems” approach for integrated development of Hardware and Software.
- Project teams are formed including “Software Engineer” in overall design.
- Thus, software impact can be minimized in overall design (or traded-off)

Reduce-Reuse-Recycle

- New development **reduce**d by systems design approach
- Software **reused** by leveraging previously proven, documented, tested, components and utilities
- New project development is implemented separately

… and then **recycled** back when proven.

Control System Development Strategy

Common Control System - ISE has developed a control system with a modular open architecture that is common to ISE products. The control system for any project is implemented by selecting re-usable components from a library and configuring them to fit the mission requirements.

Graphical User Interface – Configured from modular graphical widgets and standardized hardware. This simplifies production, troubleshooting, and training.

ISE's proven capability is attributed to our robust, flexible, adaptable control software.

Open Architecture Software

ACE Professional Software Development Kit

- 15 years development and field validation.
- Mature reusable software reduces project risks in technical, budgetary and scheduling aspects.
- Code, documentation and processes are well established.

ISE’s Modular Open Architecture Software

- facilitates complex integrations
- common interfaces and protocols for interoperability
- rapid GUI prototyping and modifications
- adjust vehicle behavior

What is ACE ?

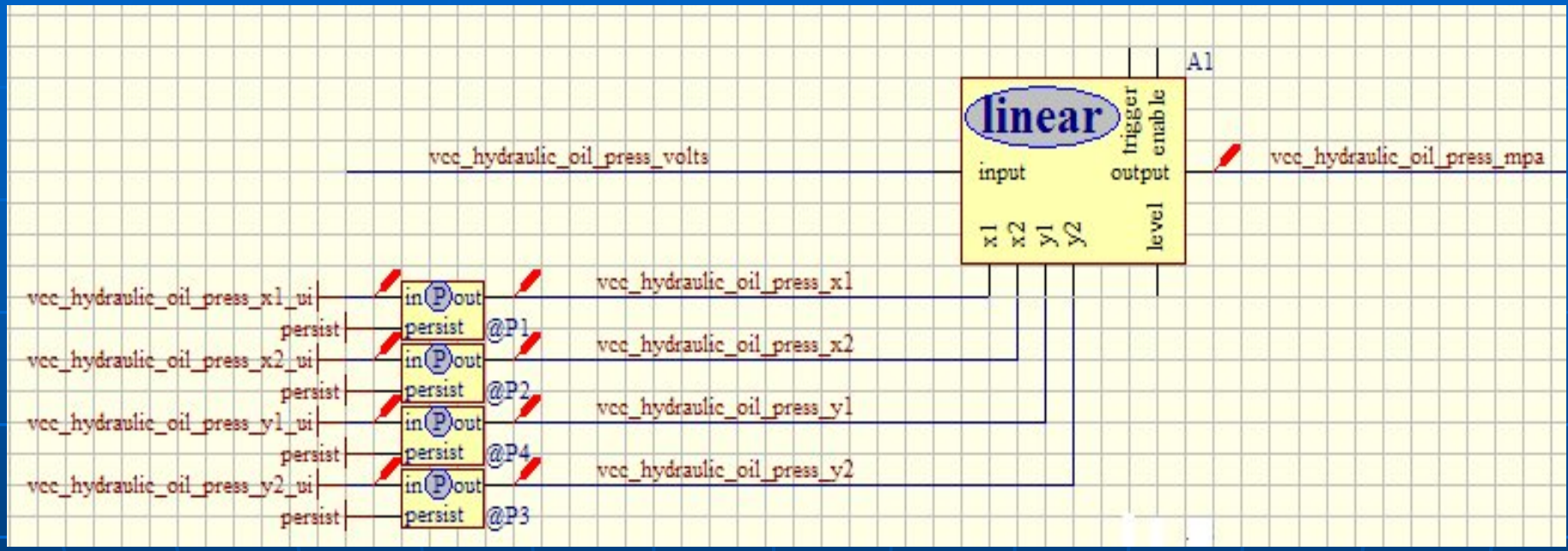
It is ISE's in house "Automated Control Engine", consisting of:

- Libraries of Components, encapsulated in C++ class which export functionality via common API
- Components which execute when triggered by an action, and produce event data output
- Components are linked at runtime, by "events", in a configuration that is produced graphically.

Graphical Control System

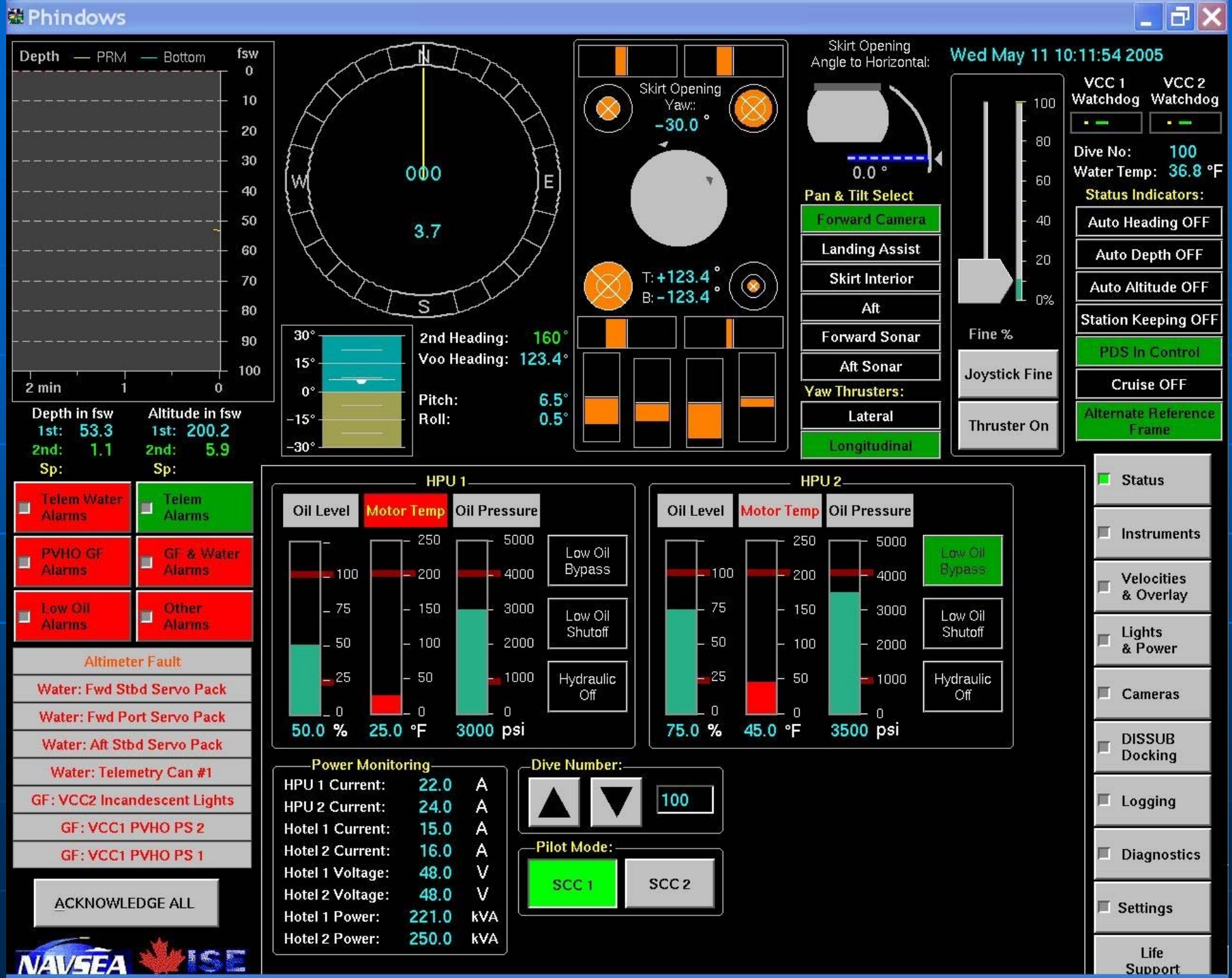
- ACE is configured in “Electrical Schematic” format
- Component icons are placed, and connected to graphically represent control data flow
- Graphical layout aids design and understanding – leading to fewer errors
- Runtime configuration also applies to GUI’s

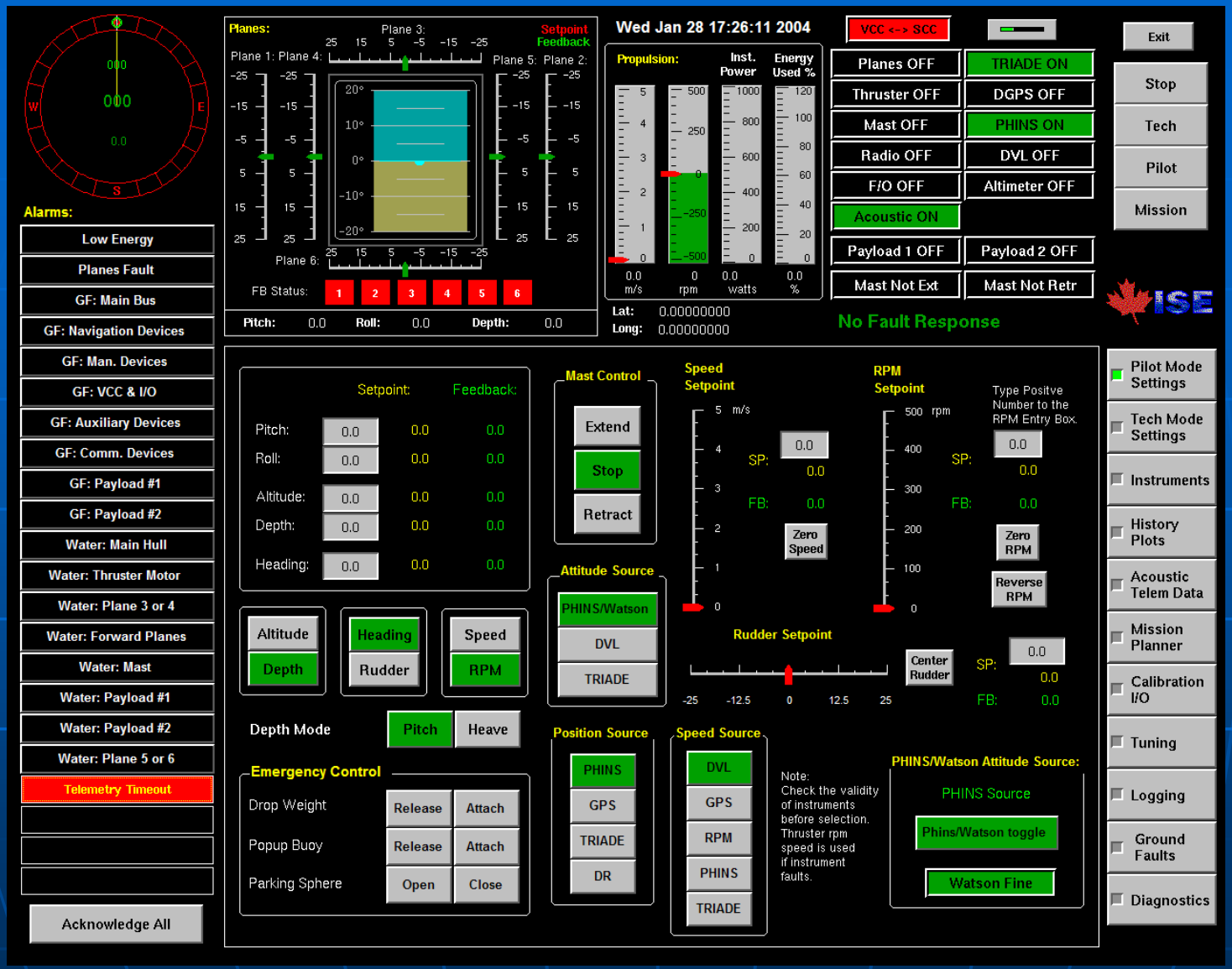
ACE Configuration



Example, “Linear Conversion”

Input is in units Volts
Output is in units mpa
Scaling parameters can be changed online

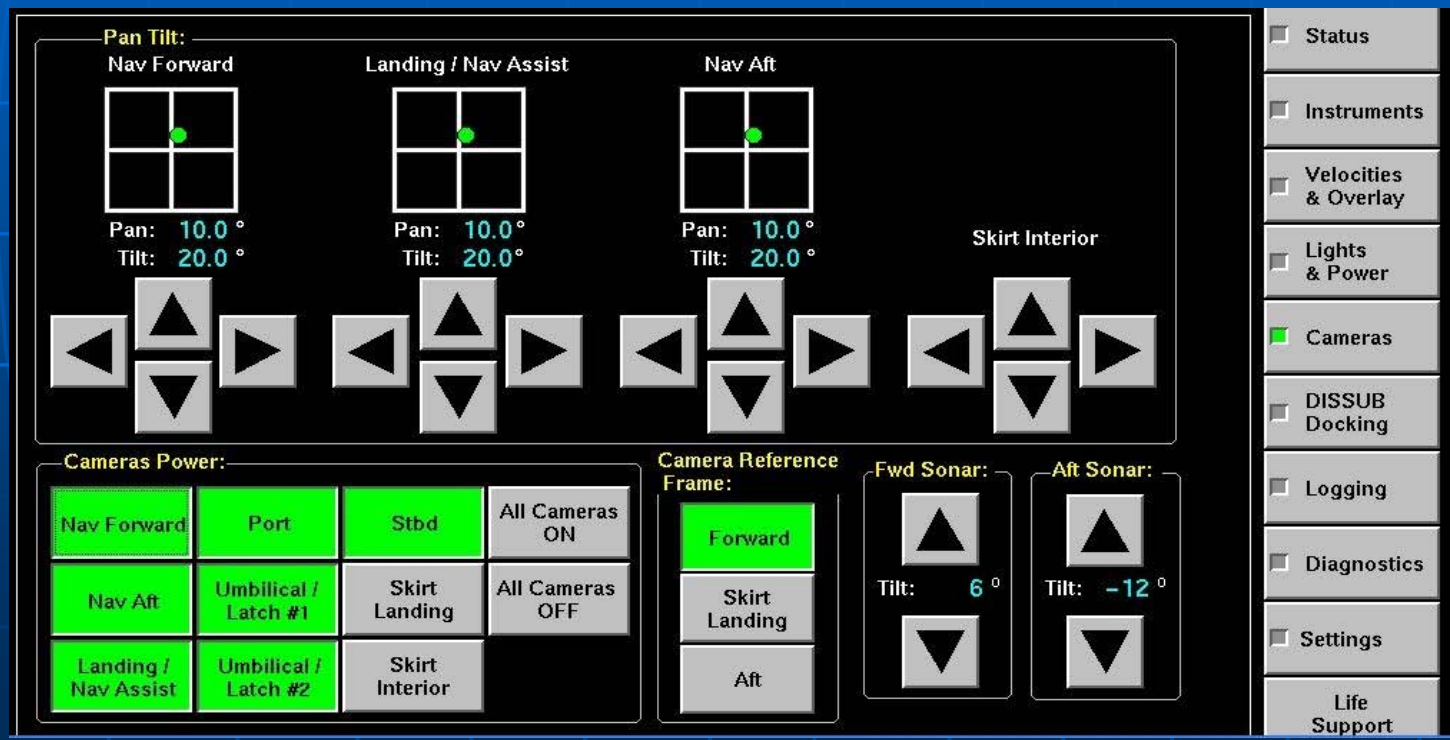

Phindows
Depth — PRM — Bottom
fsw
0
10
20
30
40
50
60
70
80
90
100
2 min
1
0
N
W
E
S
000
3.7
30°
15°
0°
−15°
−30°
2nd Heading: 160°
Voo Heading: 123.4°
Pitch: 6.5°
Roll: 0.5°
Skirt Opening Yaw:: -30.0 °
T: +123.4 °
B: -123.4 °
Skirt Opening Angle to Horizontal:
0.0 °
Wed May 11 10:11:54 2005
Pan & Tilt Select
Forward Camera
Landing Assist
Skirt Interior
Aft
Forward Sonar
Aft Sonar
Yaw Thrusters:
Lateral
Longitudinal
100
80
60
40
20
0%
Fine %
Joystick Fine
Thruster On
VCC 1 Watchdog
VCC 2 Watchdog
Dive No: 100
Water Temp: 36.8 °F
Status Indicators:
Auto Heading OFF
Auto Depth OFF
Auto Altitude OFF
Station Keeping OFF
PDS In Control
Cruise OFF
Alternate Reference Frame
Depth in fsw
1st: 53.3
2nd: 1.1
Sp:
Altitude in fsw
1st: 200.2
2nd: 5.9
Sp:
Telem Water Alarms
Telem Alarms
PVHO GF Alarms
GF & Water Alarms
Low Oil Alarms
Other Alarms
Altimeter Fault
Water: Fwd Stbd Servo Pack
Water: Fwd Port Servo Pack
Water: Aft Stbd Servo Pack
Water: Telemetry Can #1
GF: VCC2 Incandescent Lights
GF: VCC1 PVHO PS 2
GF: VCC1 PVHO PS 1
ACKNOWLEDGE ALL
HPU 1
Oil Level
Motor Temp
Oil Pressure
Low Oil Bypass
Low Oil Shutoff
Hydraulic Off
50.0 %
25.0 °F
3000 psi
HPU 2
Oil Level
Motor Temp
Oil Pressure
Low Oil Bypass
Low Oil Shutoff
Hydraulic Off
75.0 %
45.0 °F
3500 psi
Power Monitoring
HPU 1 Current: 22.0 A
HPU 2 Current: 24.0 A
Hotel 1 Current: 15.0 A
Hotel 2 Current: 16.0 A
Hotel 1 Voltage: 48.0 V
Hotel 2 Voltage: 48.0 V
Hotel 1 Power: 221.0 kVA
Hotel 2 Power: 250.0 kVA
Dive Number:
100
Pilot Mode:
SCC 1
SCC 2
Status
Instruments
Velocities & Overlay
Lights & Power
Cameras
DISSUB Docking
Logging
Diagnostics
Settings
Life Support
NAVSEA
ISE



User can modify the appearance and functionality

Graphical “Widgets”

Code reuse extends to GUI’s by standardized Widget, design, interface and export in ACE SDK

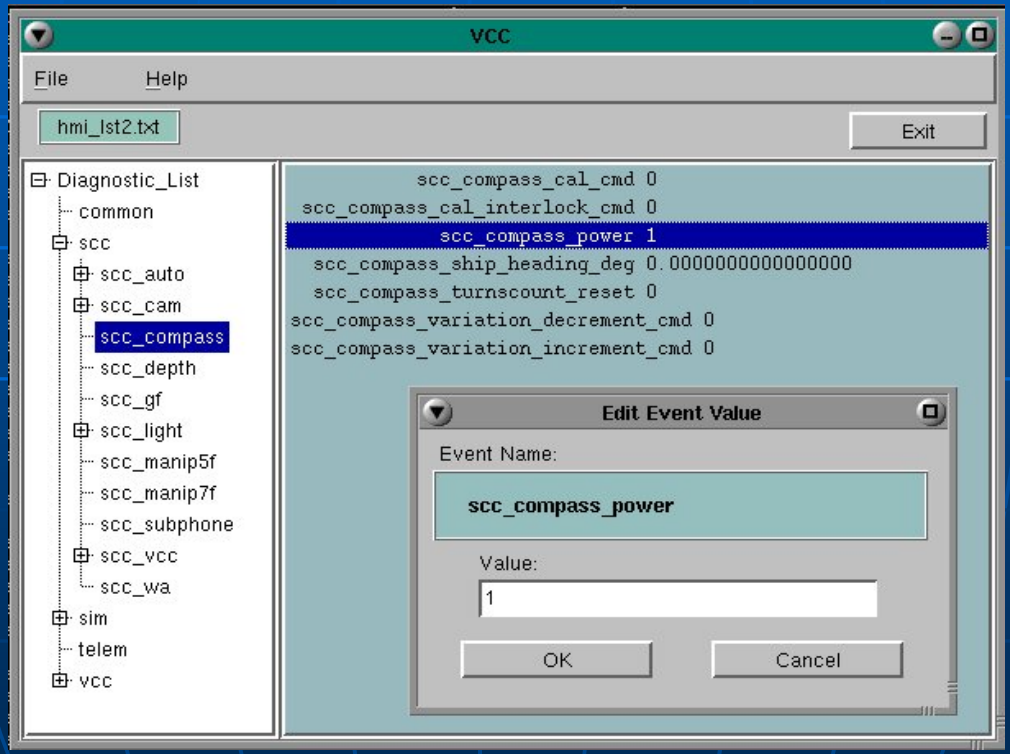


Diagnostics and Settings

Can be integrated into the GUI

Diagnostics & Troubleshooting

Generic “Diagnostic List” for real-time diagnostics and system tuning



Software Development Process

Document Control

- standardized authoring, review, approval and distribution

Software Configuration Management

- All software under Revision Control System
- Change Request, Approval, Implementation & Testing process in place
- Coding Standards
- Peer reviews, catch faults early!

Summary

- ACE SDK is a software toolbox of tested components and configurations for a variety of applications.
- System similarities result in field proven software, documented and controlled.
- Capability is demonstrated.
- Development process reduces cost and risk of new software.

THE END

info@ise.bc.ca

www.ise.bc.ca