3D Visualisation & Human Machine Interaction

Submarine Rescue Systems

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Warship Submarines 9, RINA 2008

3D Visualisation of Submarine Rescue Systems and Rescue Mission Simulation

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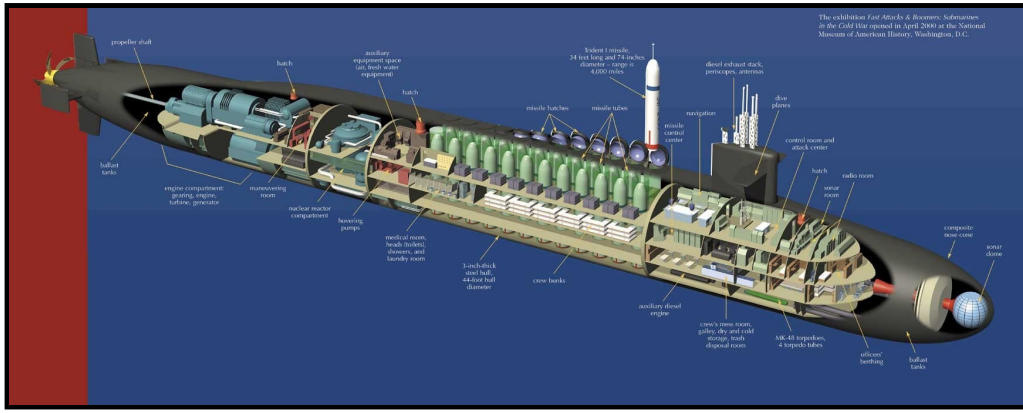
Contemporary CAD

Computer Aided Design (CAD)

- 2D/3D Surface (i.e. pro-engineer, CATIA, etc.)
- Volume development (i.e. solid-works)
- Mechanical Components animation (i.e. inventor)
- Animate operation sequences as non-interactive, off-line rendered video using fixed cameras

Typical CAD Outputs

- 3D format files
- Limited or Non-interactive data (explanatory animations)



Typical Output Constrains

Assess operational aspects in real time

Data Manipulation Study

Solution Under Investigation

- Real-time feedback Human-Computer Interface (HCI)
- VR simulation
- Interactive data manipulation tools
- User-friendly (usage from non-computer specialists)

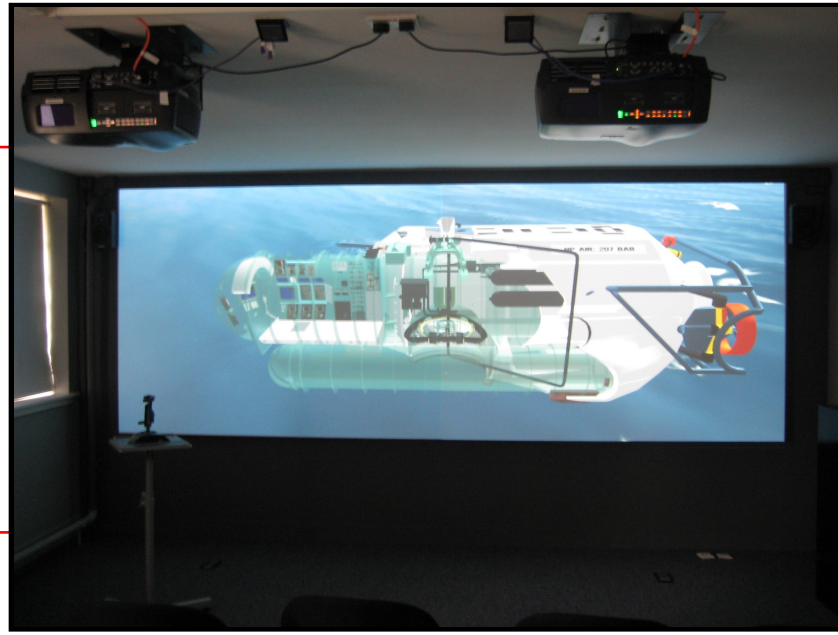
Rationale

1. Design evaluation
2. Explanatory presentations
3. Operation training

Methods

1. Real-Time VR simulation
2. Explanatory Animations / Still images
3. Predetermined simulations and animations

Development of VR Simulation and Animation



3D Visualisation software

- Autodesk Maya 2008

VR Simulation software

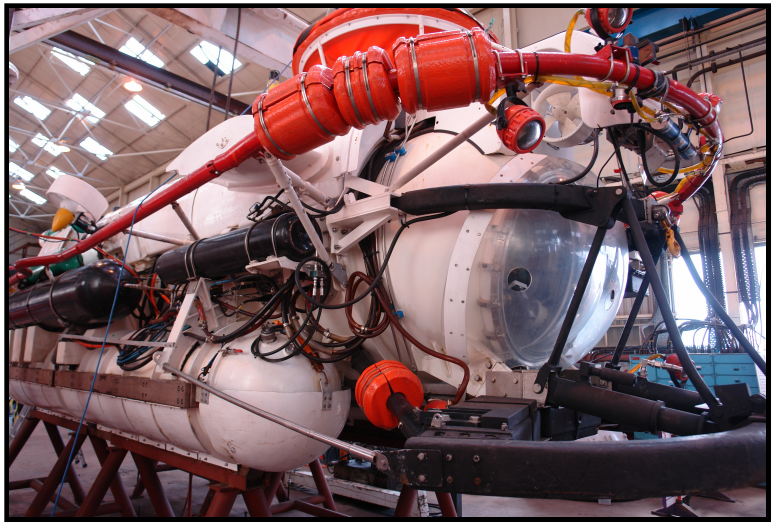
- VEGA

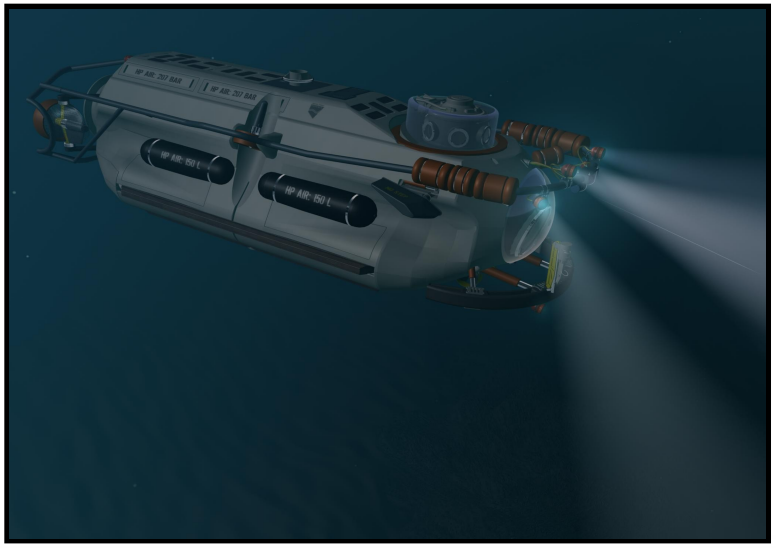
Virtual Reality Simulator hardware

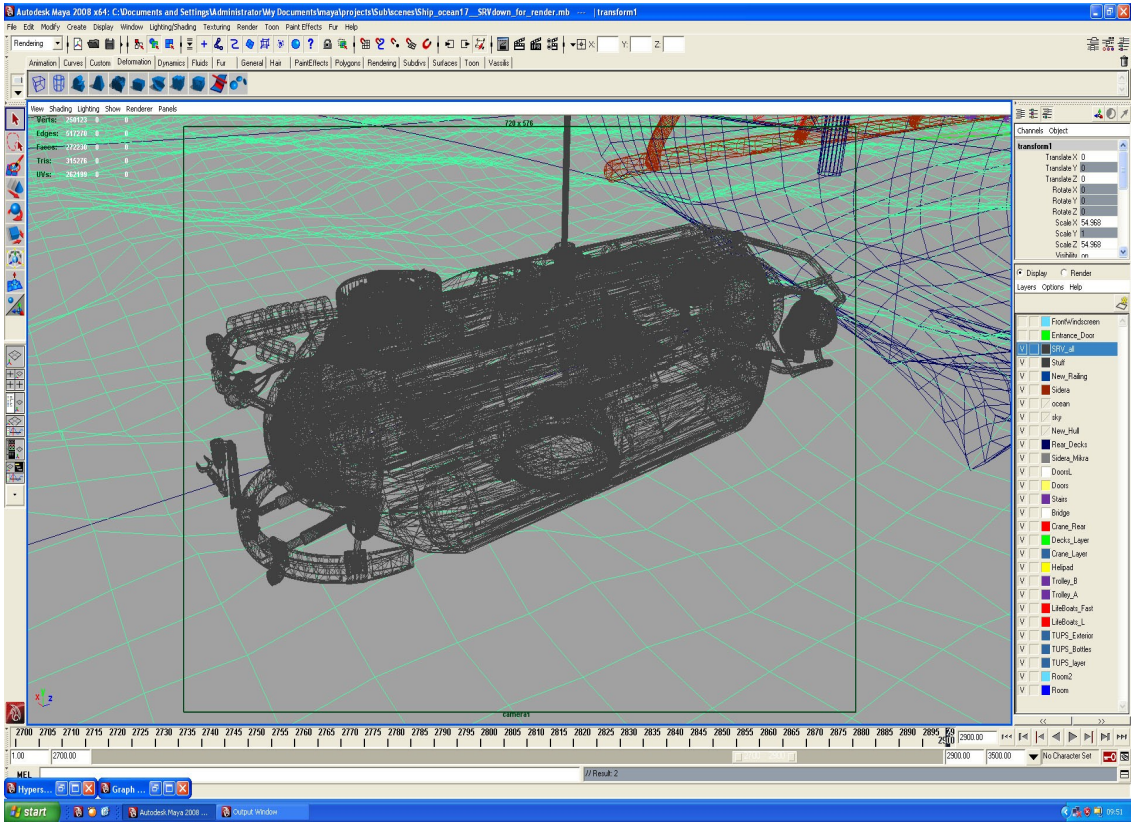
A range of VR display environments for our experiments,

- including stereoscopic projection
  (providing a sense of depth) that enables better understanding of the spatial structure,
- **high-resolution wide screen** (2800 x 1050 pixels on 4.4m x 1.65m)
  to convey a feeling of the actual size of the SRV.
- All our display systems are **driven by PC workstations**
  (with dual Xeon processors and nVidia Quadro FX4400 graphic)

Modelling






Autodesk Maya 2008 x64: C:\Documents and Settings\Administrator\My Documents\maya\projects\Sub\scenes\Ship_ocean17__SRVdown_for_render.mb --- | transform1

Environment Simulation

Environment Simulation

Design Evaluation

Benefits:

- Allowing processes to be:
  (a) repeated
  (b) from multiple viewpoints and
  (c) played back at different speeds

- Including transparency or cutaway views to allow the review of internal mechanisms and processes

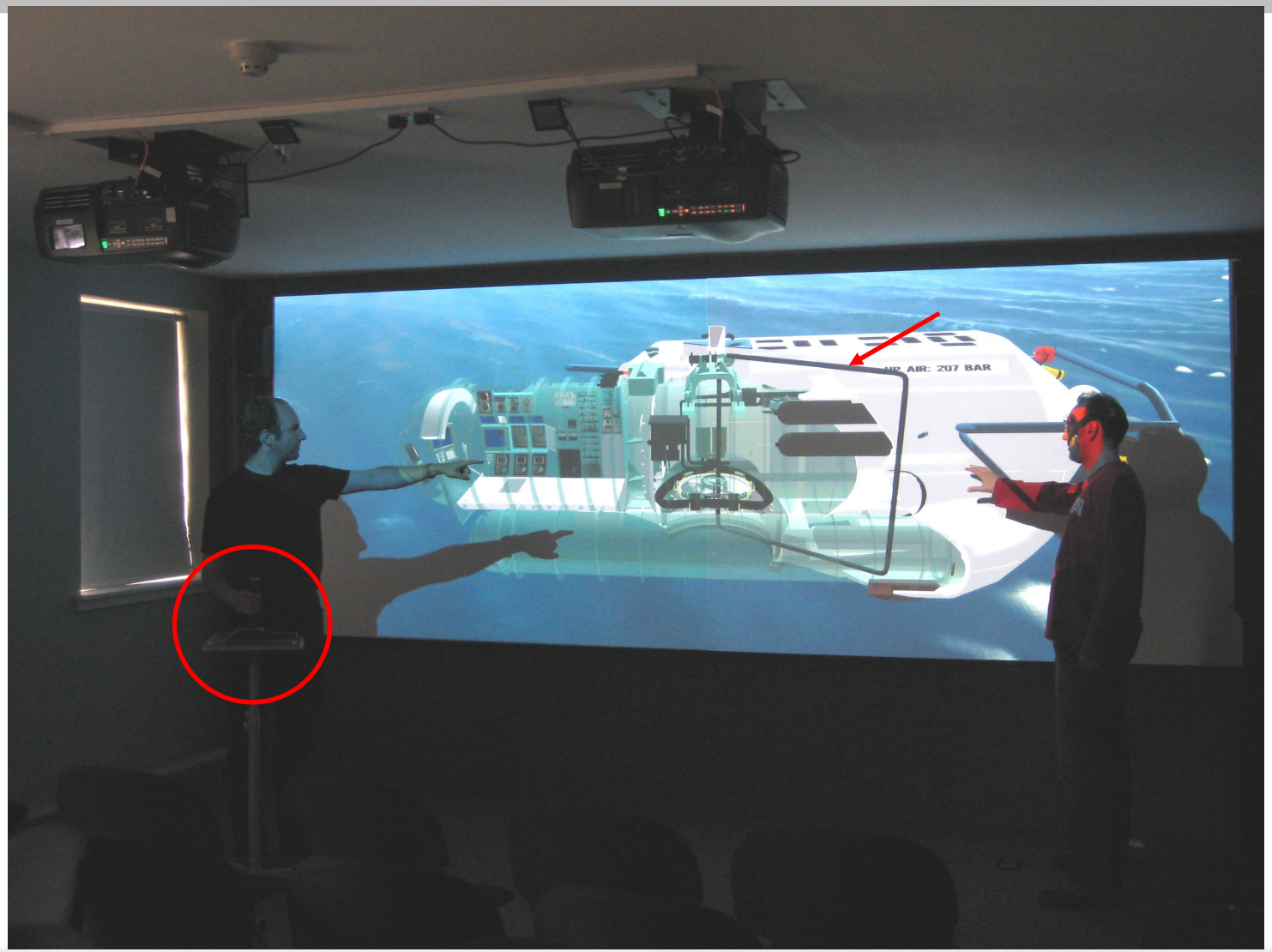
- Allowing team members with a non-technical background, (typically operators or clients), to control and manipulate the 3D environment

Charissis V., and Naef M., (2008), Functionality Simulation of Prototype Products Through Virtual Reality: Automotive Head-Up Display CaseStudy, in Proceedings of the 2nd International Symposium on Systems Research in the Arts and Humanities, part of the 20th Anniversary International Conference on Systems Research, Informatics and Cybernetics, Baden-Baden, Germany.

Naef, M., Interaction and Ergonomics Issues in Immersive Design Review Environments. Proceedings of COMPIT 2007, 23-25 April 2007, Cortona/Italy.

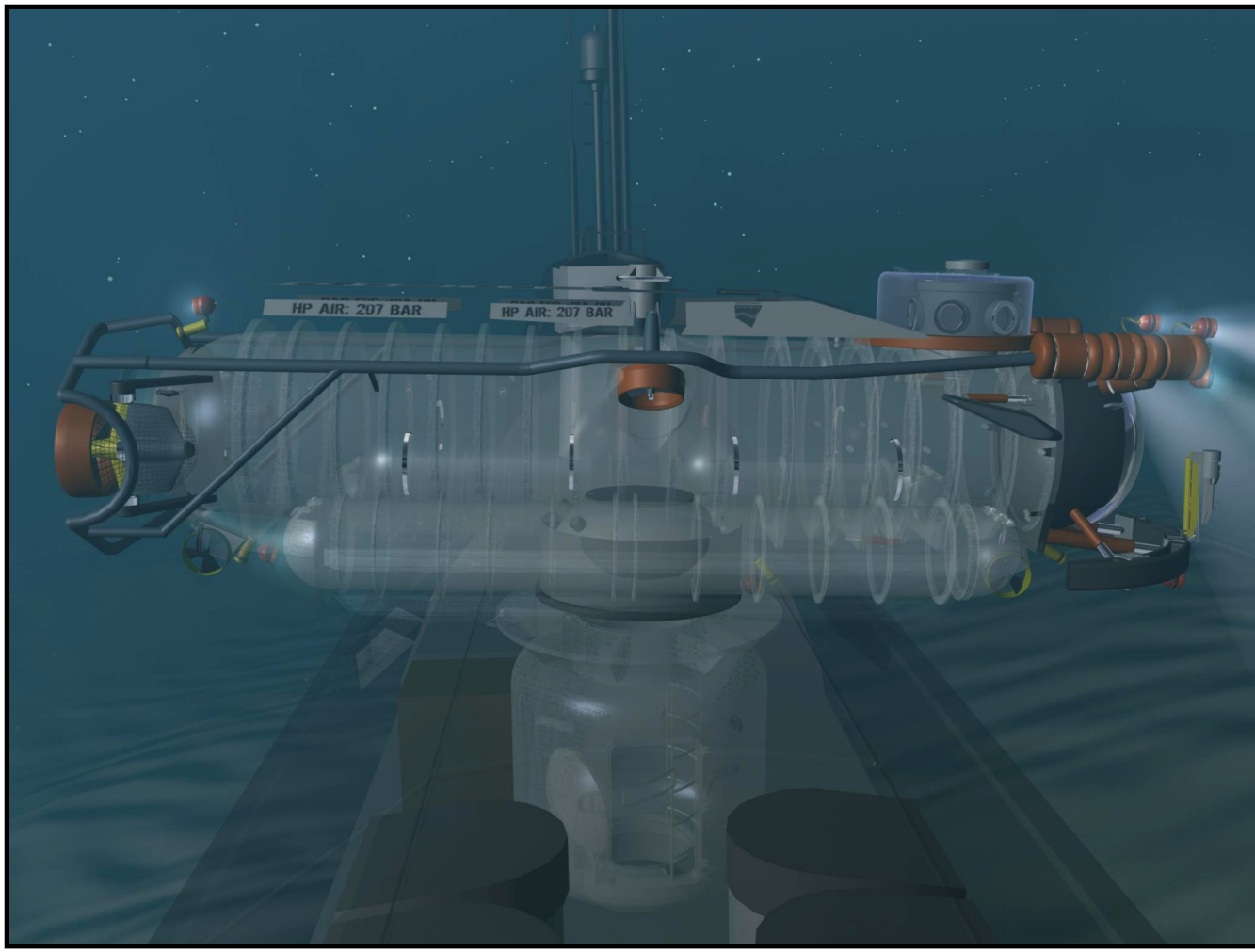
Sherwood Jones, B., Naef, M., McLundie, M.: Interactive 3D Environments for Ship Design Review and Simulation. 5th International Conference on Computer Applications and Information Technology in the Maritime Industries (COMPIT). Leiden, The Netherlands, May 8-10

Simulation Screenshot



Explanatory Presentations

- Mechanical systems
- Operational procedures

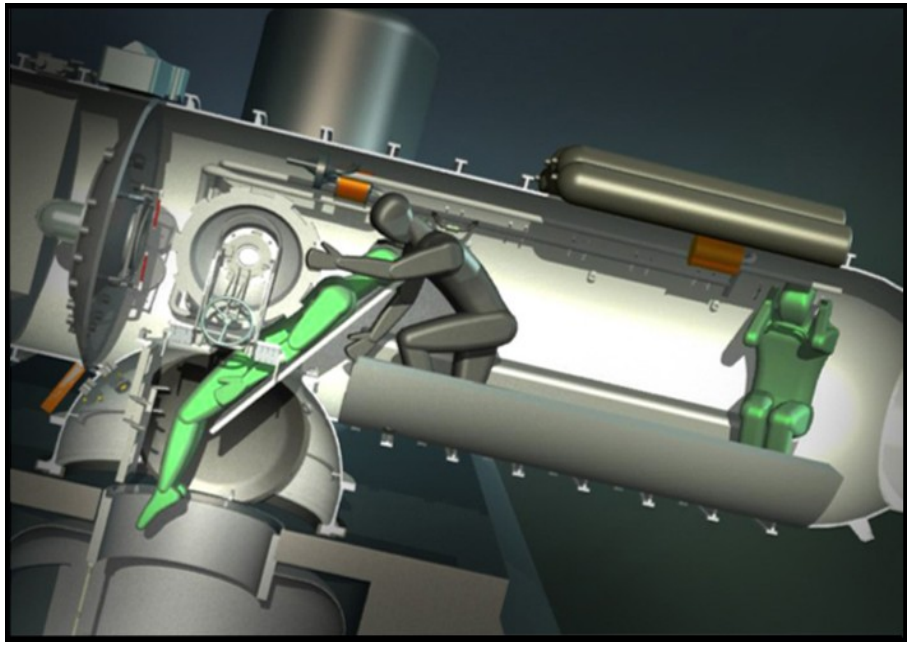


In the SRV Case Study Milestones:

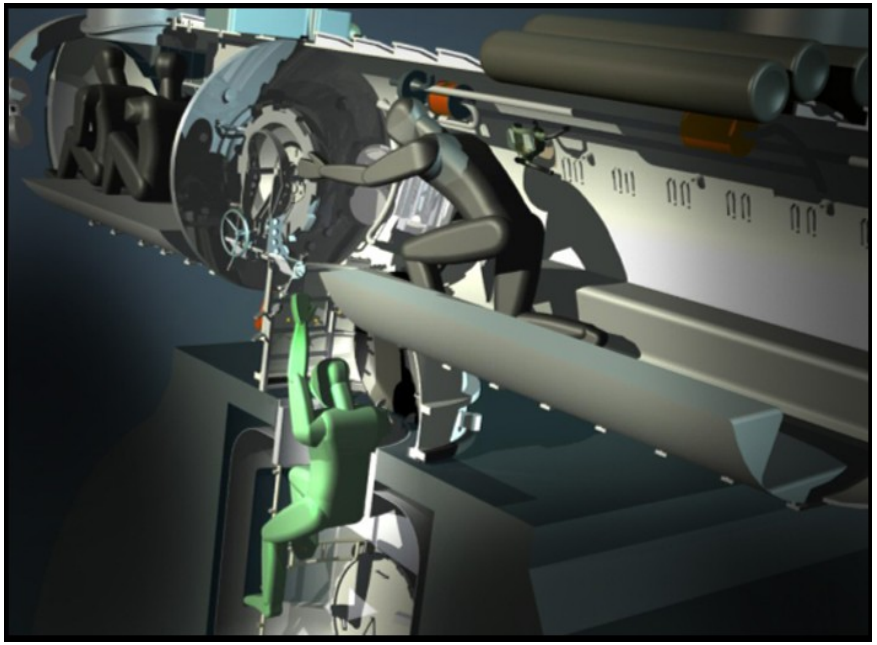
3. The SRV modelling with CAD software
5. Demonstration of the approach procedure with the DISSUB on the seabed,
7. Demonstration of SRV locking onto the DISSUB's rescue seat, (depressurisation of the interlock),
9. The opening of the hatches
11. The transfer of the Rescuees.
13. Visually simulation of the Evacuation of the Rescuees
15. Rescuees transfer from the DISSUB to the SRV
17. Rescuees transfer on to the decompression chambers onboard the MOSHIP.

Operation Training

Simulation of procedures ⟶ accurate depiction of the structures onboard



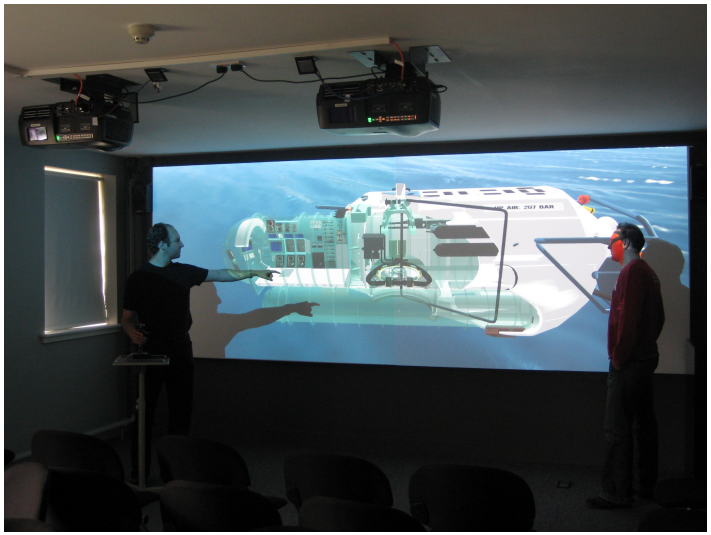
Evacuation of an immobile rescuee

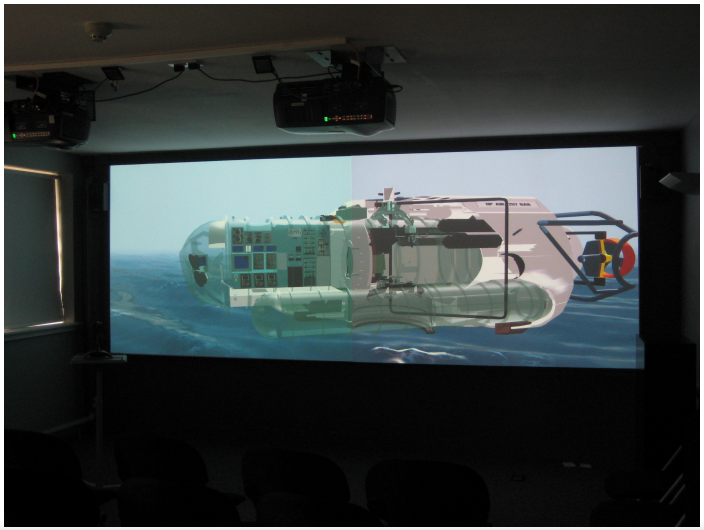


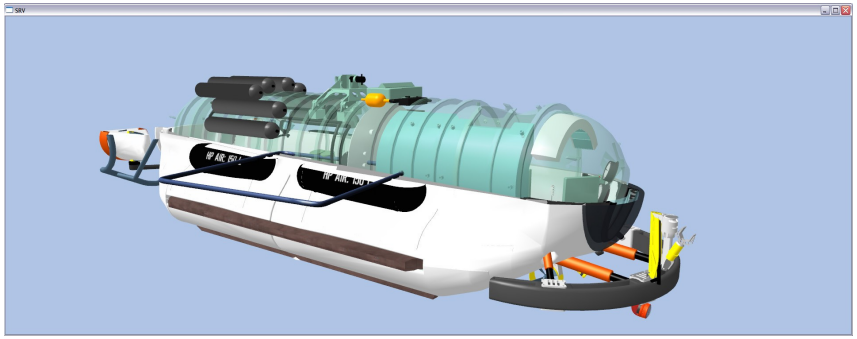
Hatch opening procedure

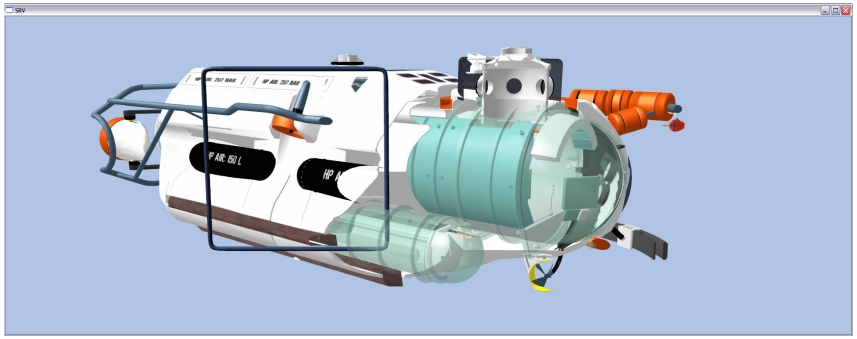
Human modelling and movements' simulation examples

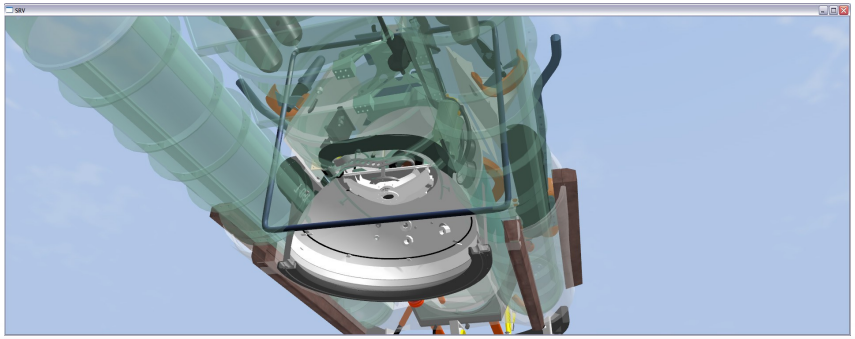
Simulation Real-Time











Conclusions

Case Study Process & Results

- 3D Visualisation of involved vessels
- Initial Simulation & Animation of procedures
- Environment simulation

Aims

- To Circumvent potential design and ergonomics issues well in advance of the completion stage

Benefits

- Evaluate in Real-Time the structural designs
- Evaluate Human Factors involved in different operations
- Fully controllable environment
- Safe environment (simulated environment)

Future Work

Expand our future work to:

1. The development of the real-time visualisation of the SRV and associated Rescue Equipment.

3. To enable non-expert users in CAD to explore and interact with the 3D environment in real-time

5. Design and development of a virtual-reality-based interface and allowing non-expert users to easily
   a. inspect,
   b. review and
   c. analyse the physical and human interactions

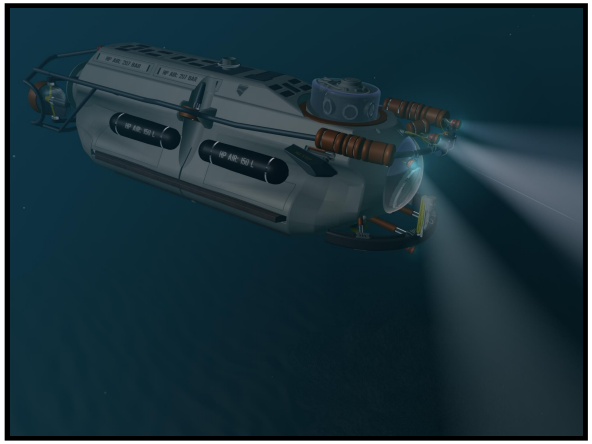
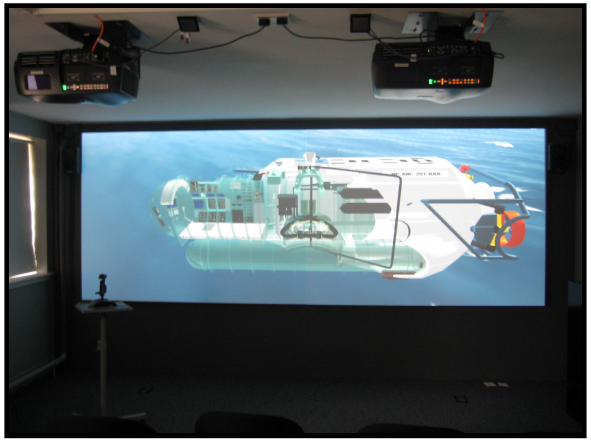
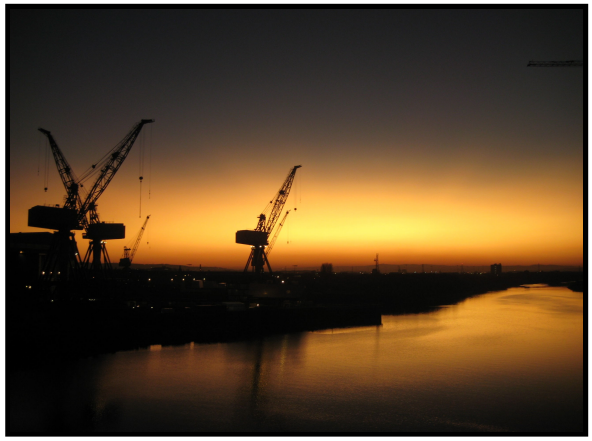
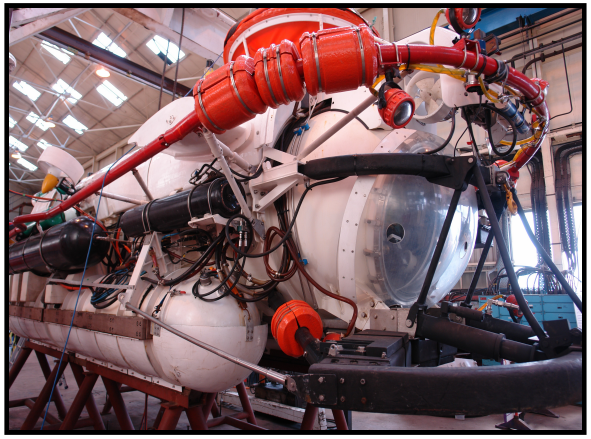
6. To prevent or minimise onboard or procedural accidents

Simulation

- Testing different simulation scenarios (series of simulations for different procedures)

Implementation

- Investigation of various interactivity avenues

Thank you very much

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