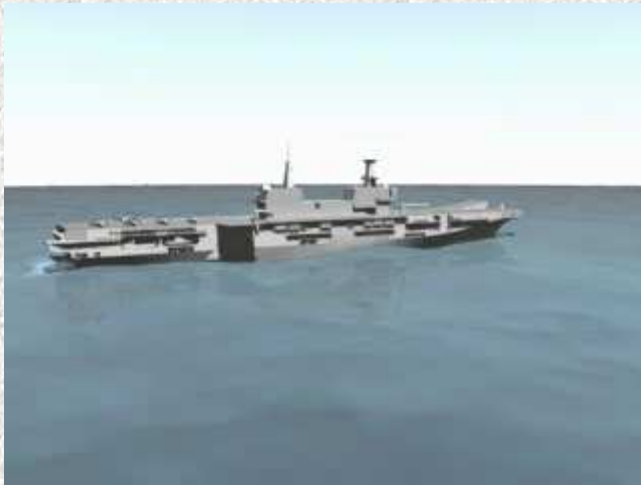

Modelling & Simulation in Naval Framework

Aldo Zini
Cetena S.p.A.

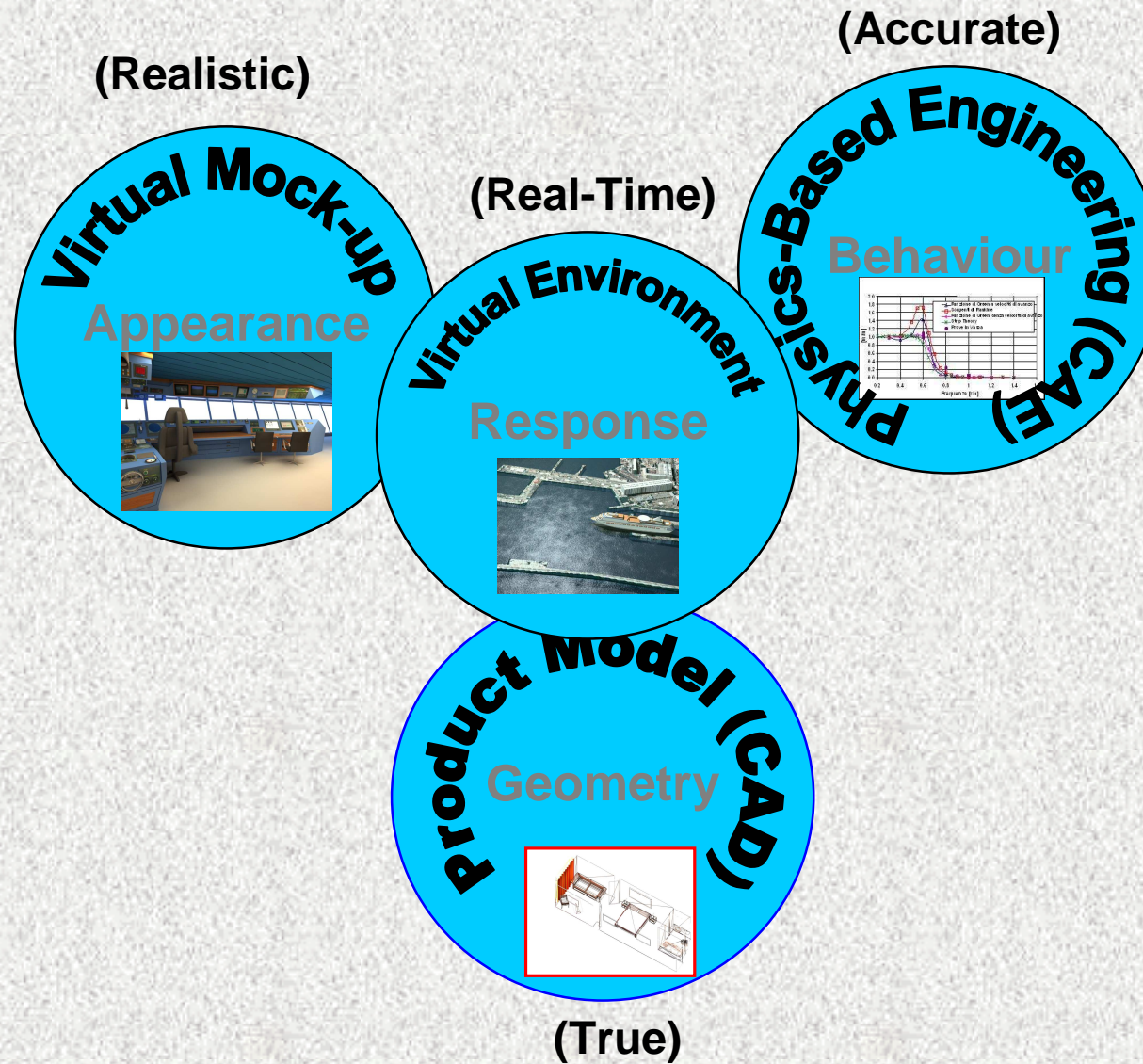
Virtual Prototype

The Virtual Prototype is a Prototype

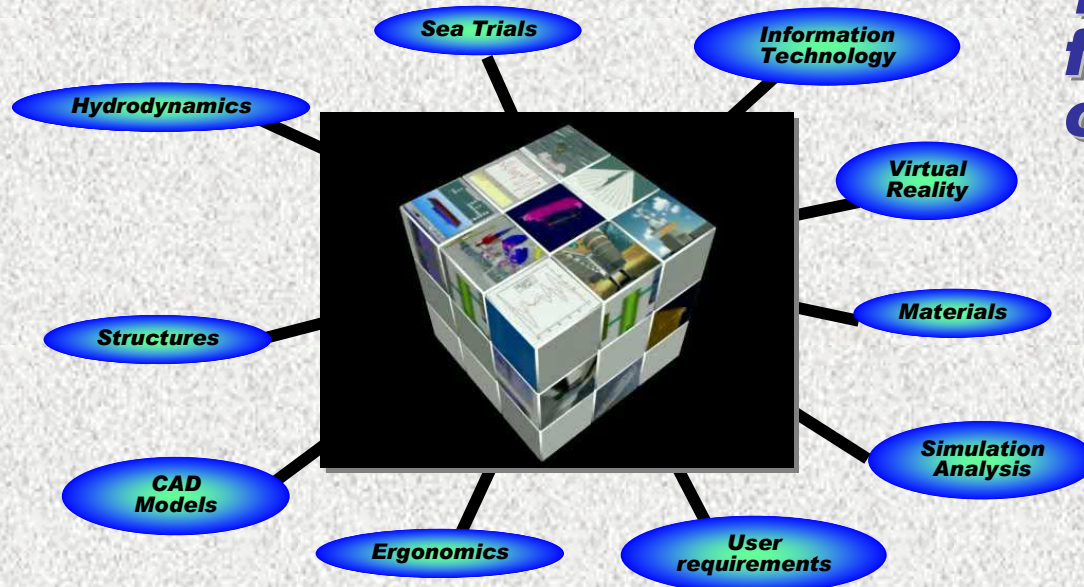


The actual ship usually is the only prototype of herself

Virtual Prototyping Elements



Why using simulation in Ship Design



To demonstrate feasibility of design choices

To verify operative requirements in dangerous/extreme situations

To assess the behaviour in operational scenarios

CONCEPT: Conceive, Design, Test, Train and Operate the Ship on Computer before Cutting Metal

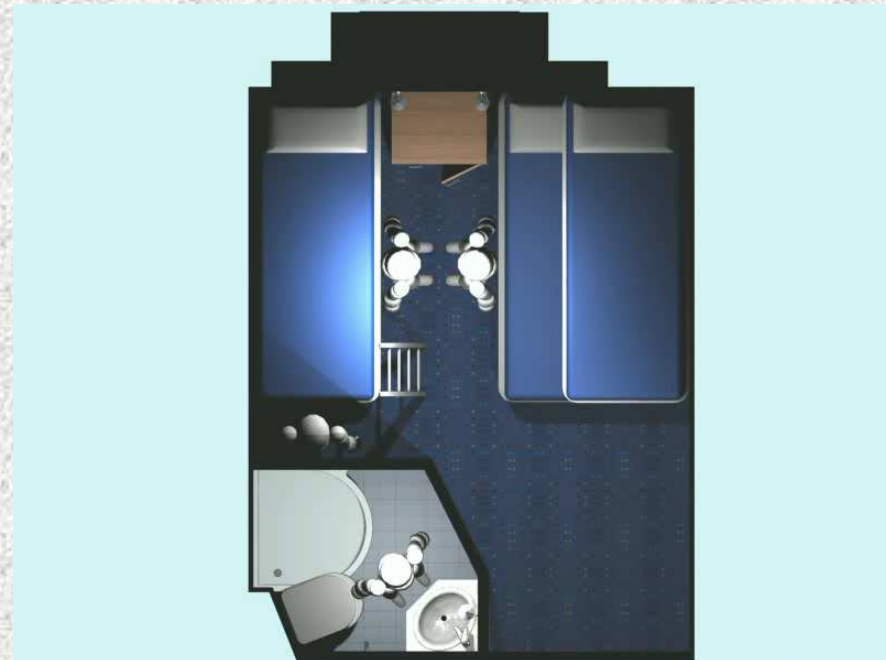
Feasibility demonstration

Ship Cabins Digital Mock-up



A standard cabin

Ergonomic Assessment

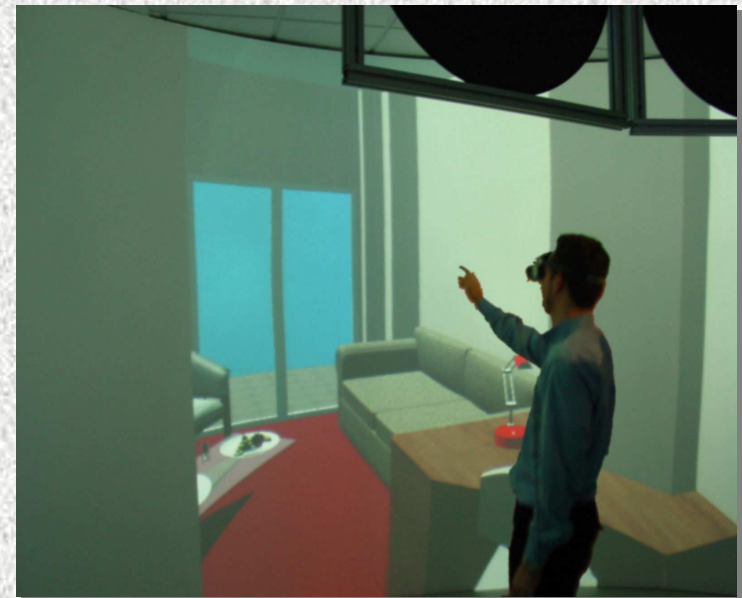


Feasibility demonstration

Head Mounted Display Applications

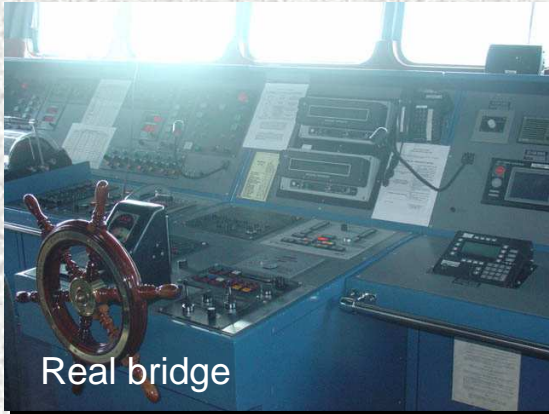


- Full immersive 3D visualization
- Trackers provided for interactive simulations

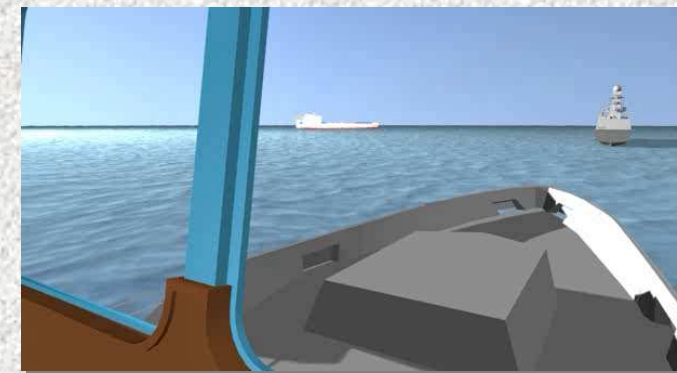


Feasibility demonstration

Bridge Mock-up

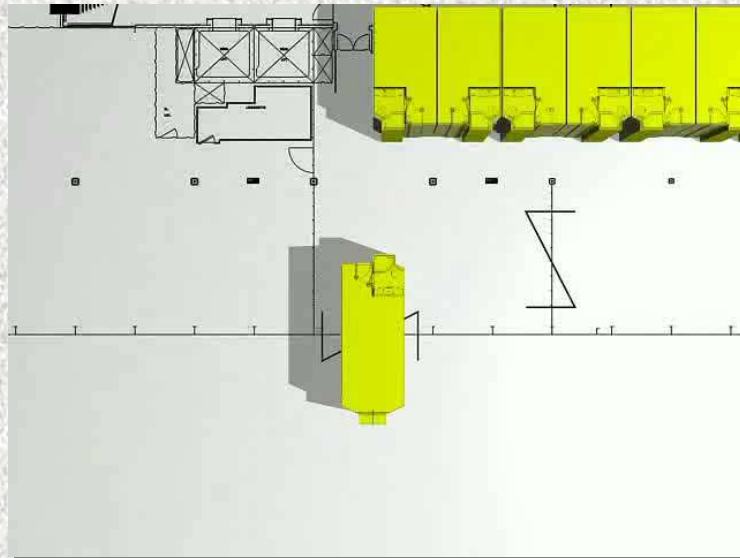


Immersive exploration of digital mock-up



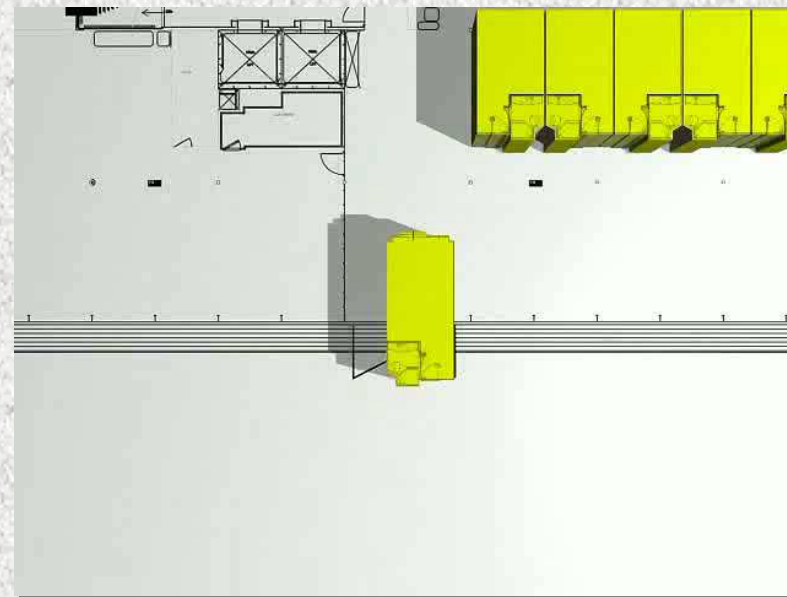
Feasibility demonstration

Positioning and Assembly of Prefabricate Cabins



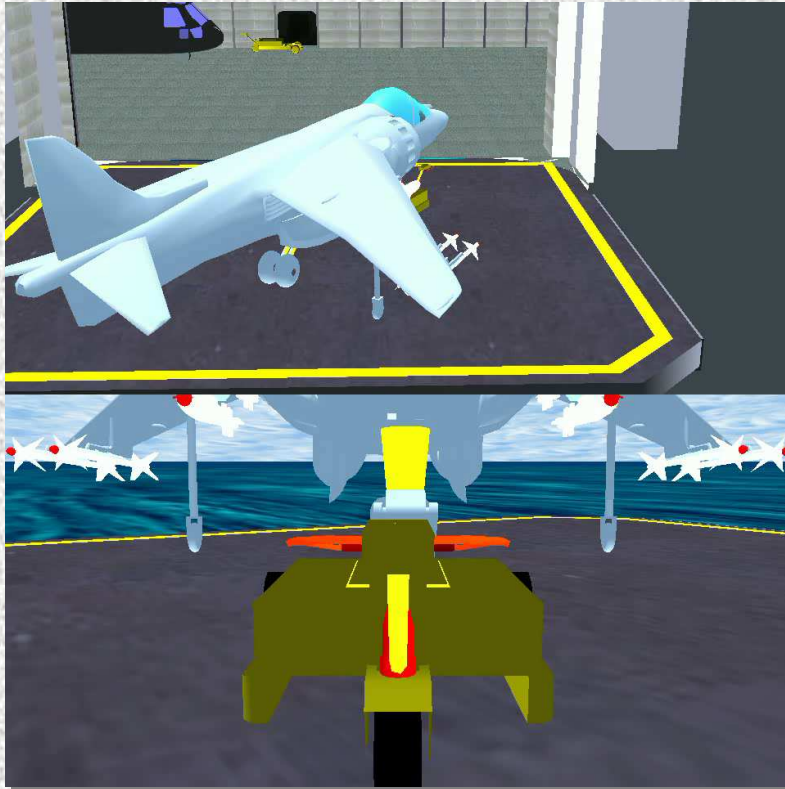
Motion path to destination

Collision detection and assembly evaluation

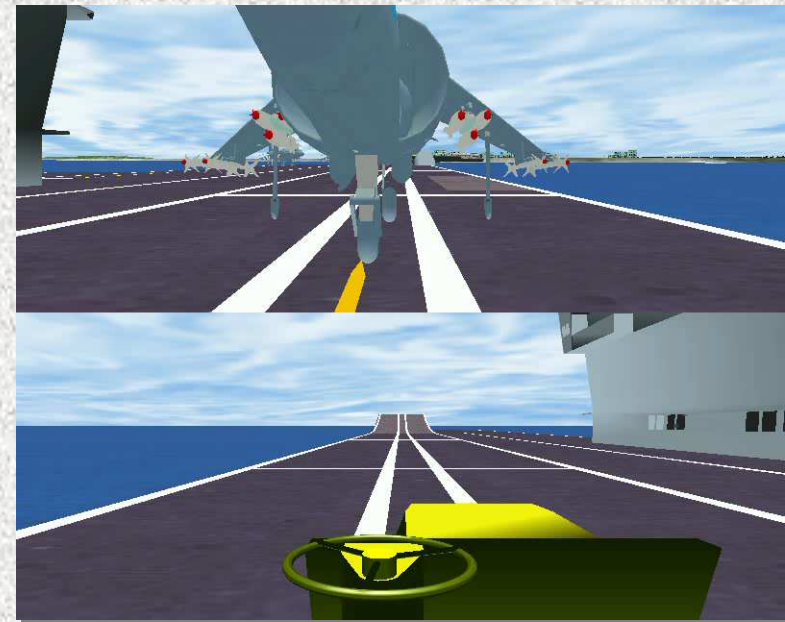
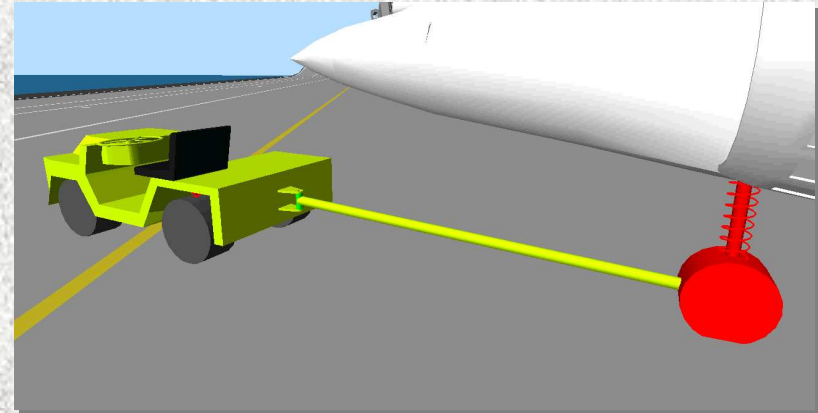


Feasibility demonstration

Onboard Aircraft Manoeuvres



Checking spaces, manoeuvres, times, and collisions.



Operational scenarios assessment

Cooperative Simulations



**Loading/unloading operation
with concurrent simulations**

Feasibility demonstration

Ergonomics

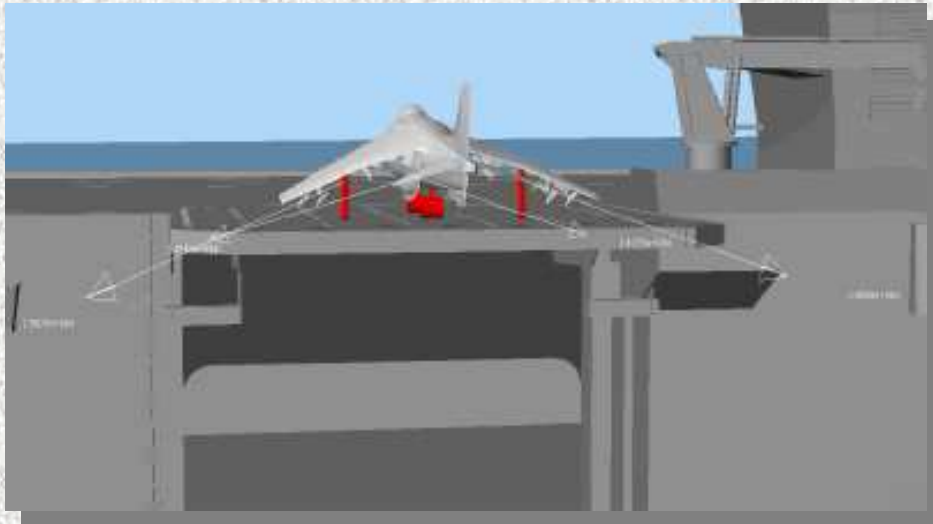


Ergonomics and fields of view
for ship deck evaluation



Dangerous/Extreme situations verification

Moving Aircrafts Onboard



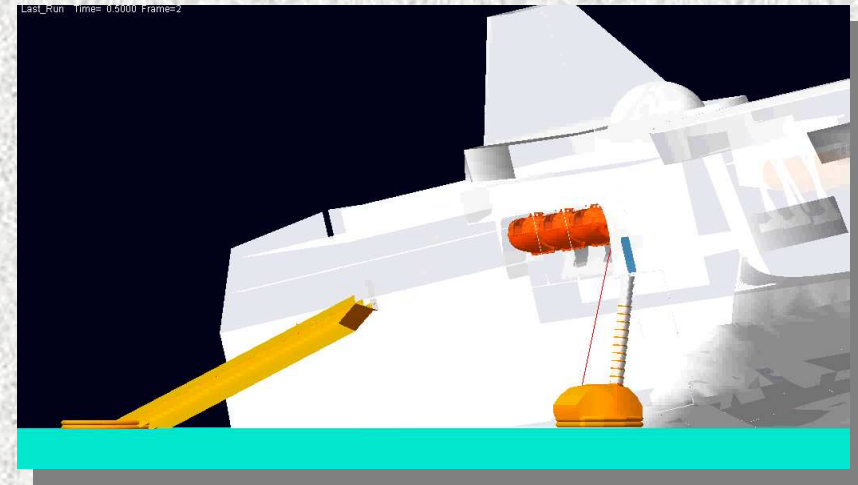
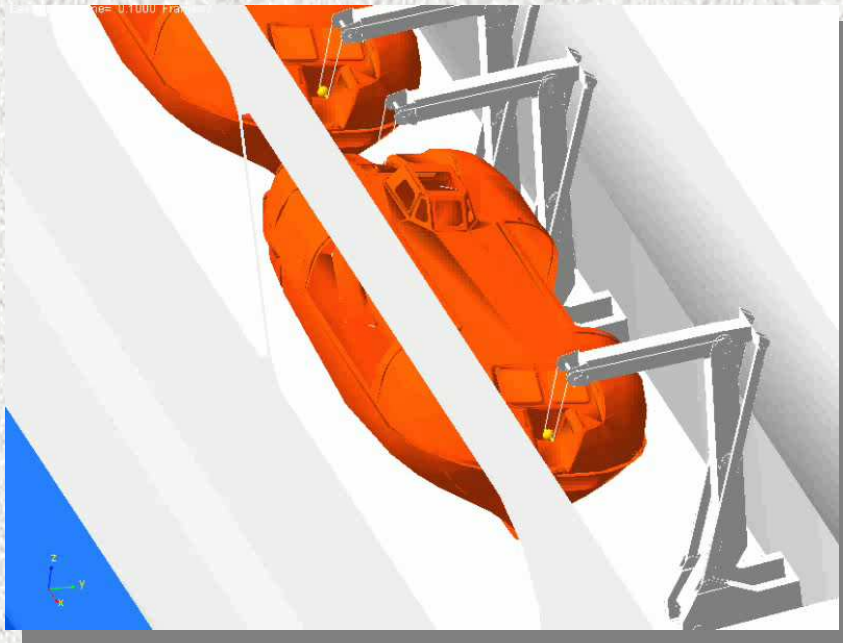
Evaluation of forces on the aircraft

Design evaluation of an external elevator



Dangerous/Extreme situations verification

Lifeboats Release Operations



Life boats release operation for checking collisions, forces and crane behaviour.



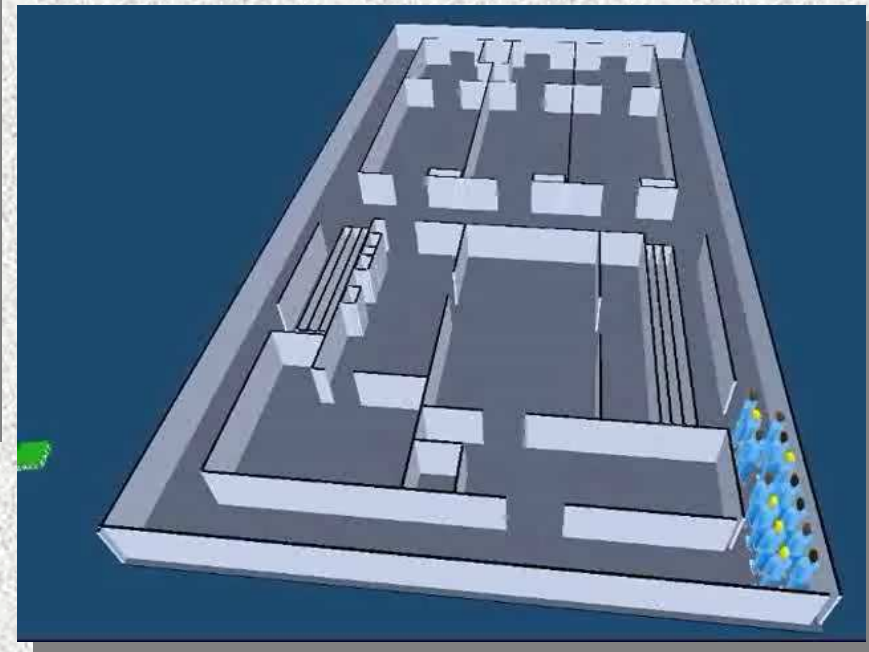
Dangerous/Extreme situations verification

Circulation and Evacuation on Board



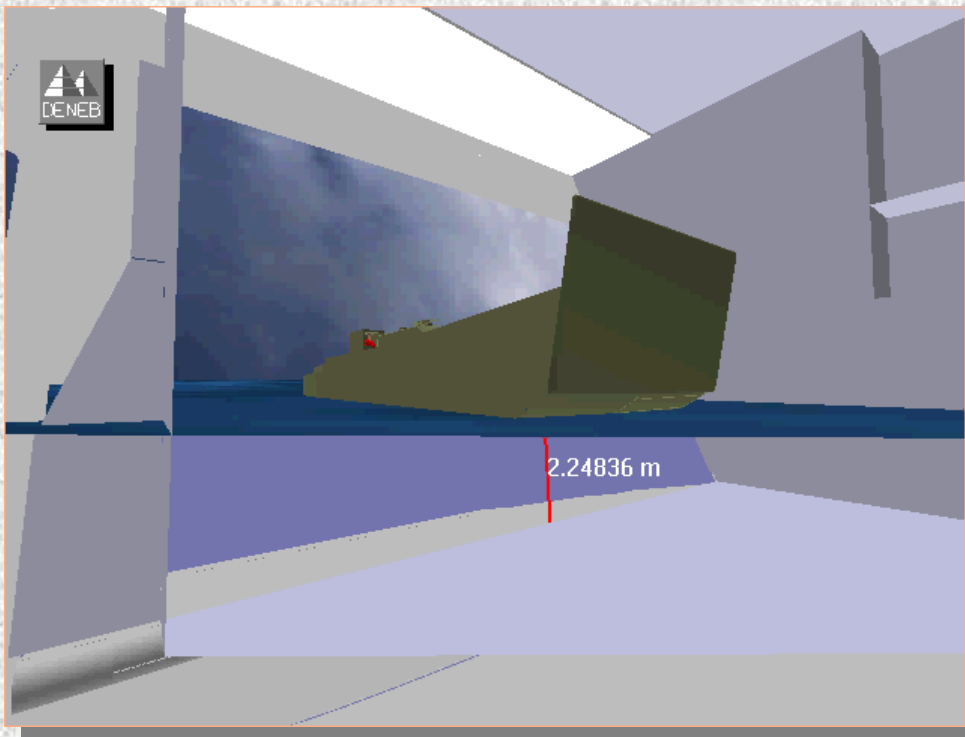
**“Microscopic”
evacuation models**

**Personnel flow
in the self service mess**



Dangerous/Extreme situations verification

Collision Detection

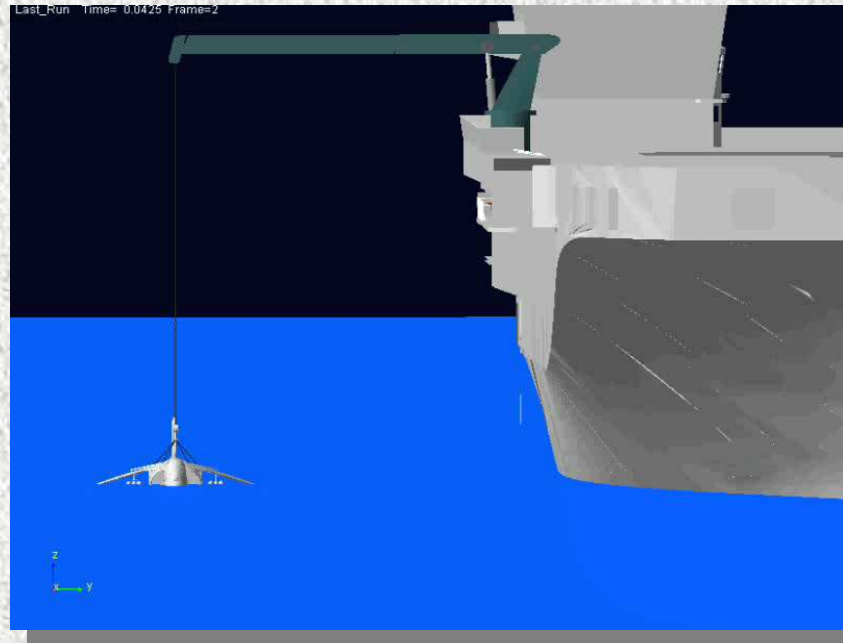


Ingress of the small boat into the wet deck of the amphibious ship for collision detection analysis.

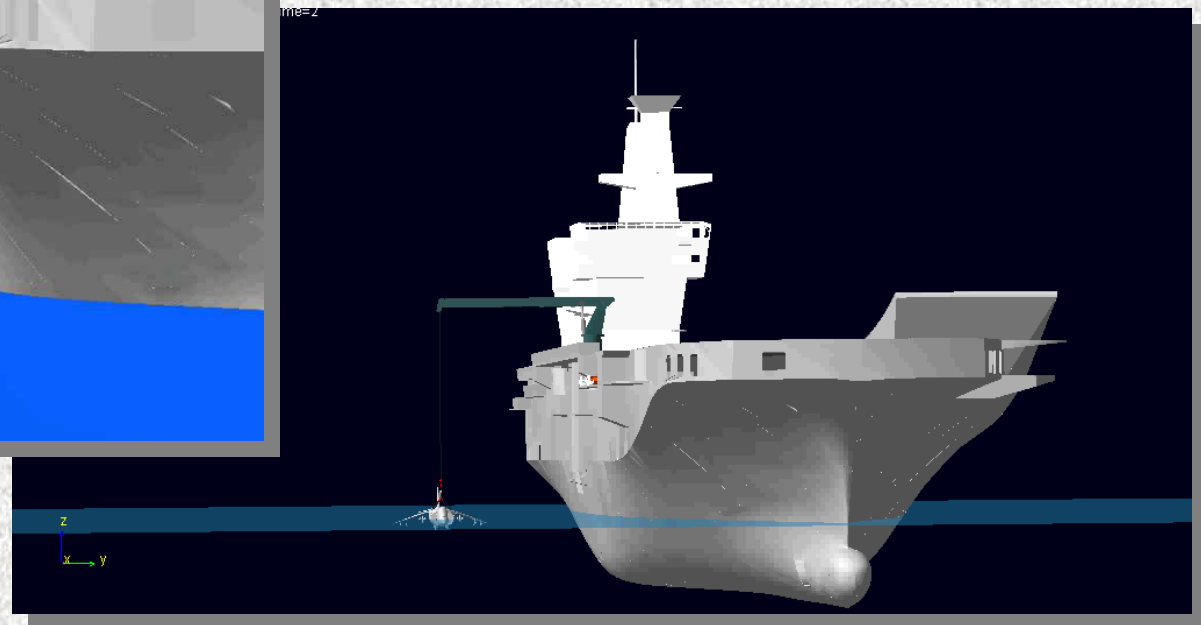
Ship motions for both ships are taken into account.

Dangerous/Extreme situations verification

Rescue Operations



Feasibility study of aircraft rescue operation in heavy sea states.



Operational scenarios assessment

**More
complexity**

**Multiple
Entities**

**Real-time
visualization**

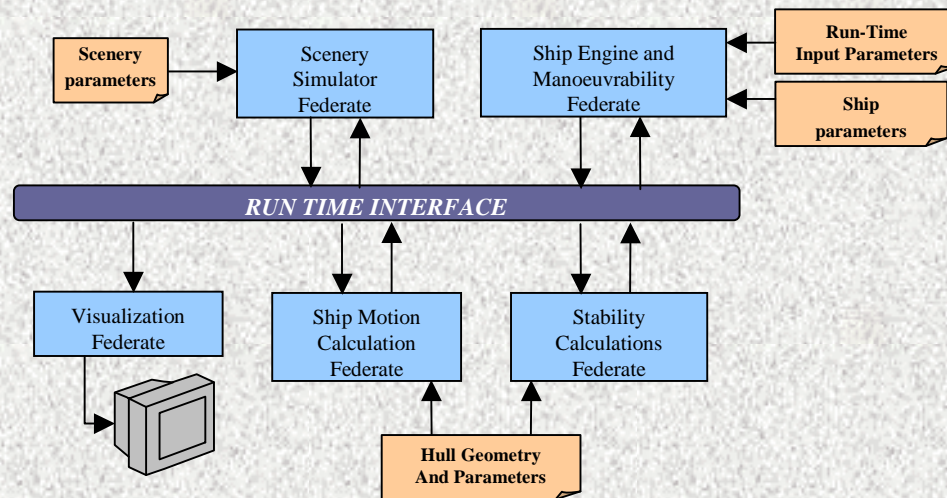


**Environment
interaction**

**Interactive
Behaviour
(man in the loop)**

Operational scenarios assessment

Simulation of Platform



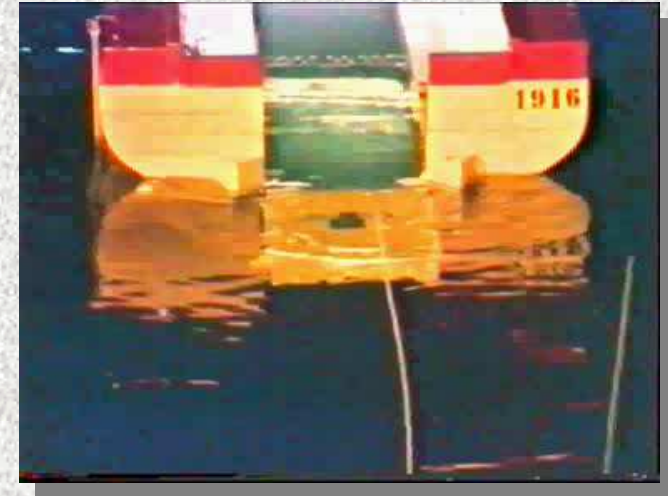
Ship motion and manoeuvrability behaviour are calculated in real-time and visualised in a 3D synthetic environment

Operational scenarios assessment

Operation Analysis and Verifications

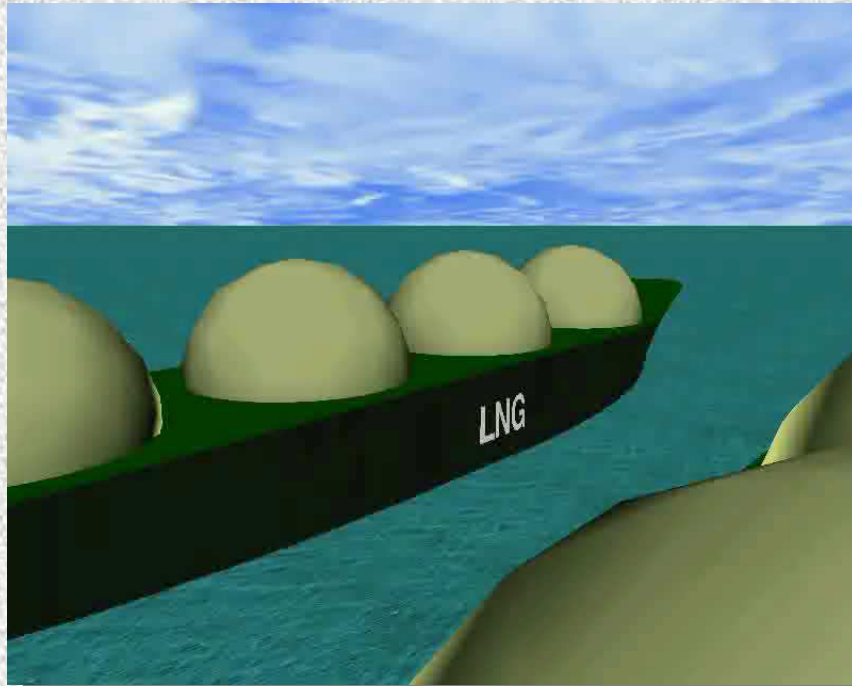


Behaviour of the landing craft approaching amphibious ship



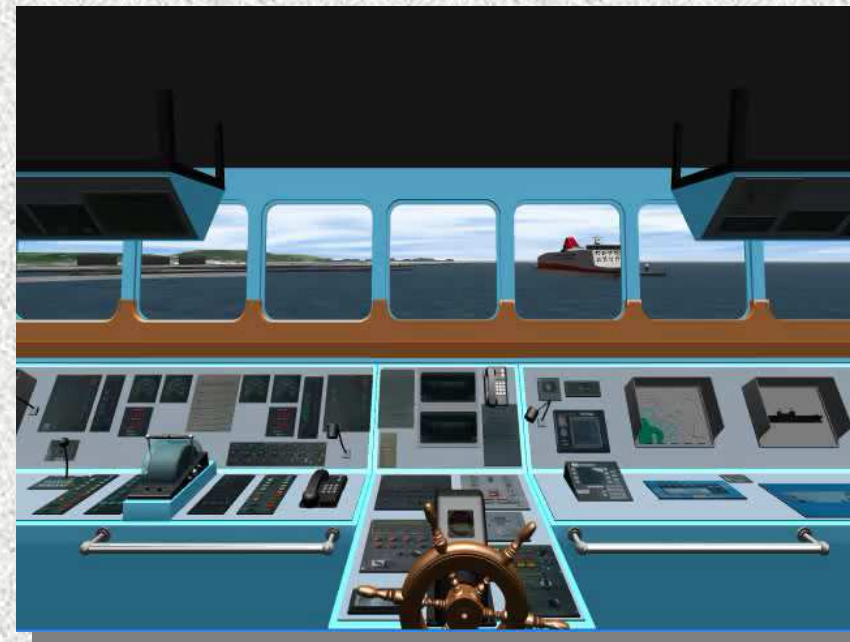
Operational scenarios assessment

Operational Verifications



Two ship cooperating

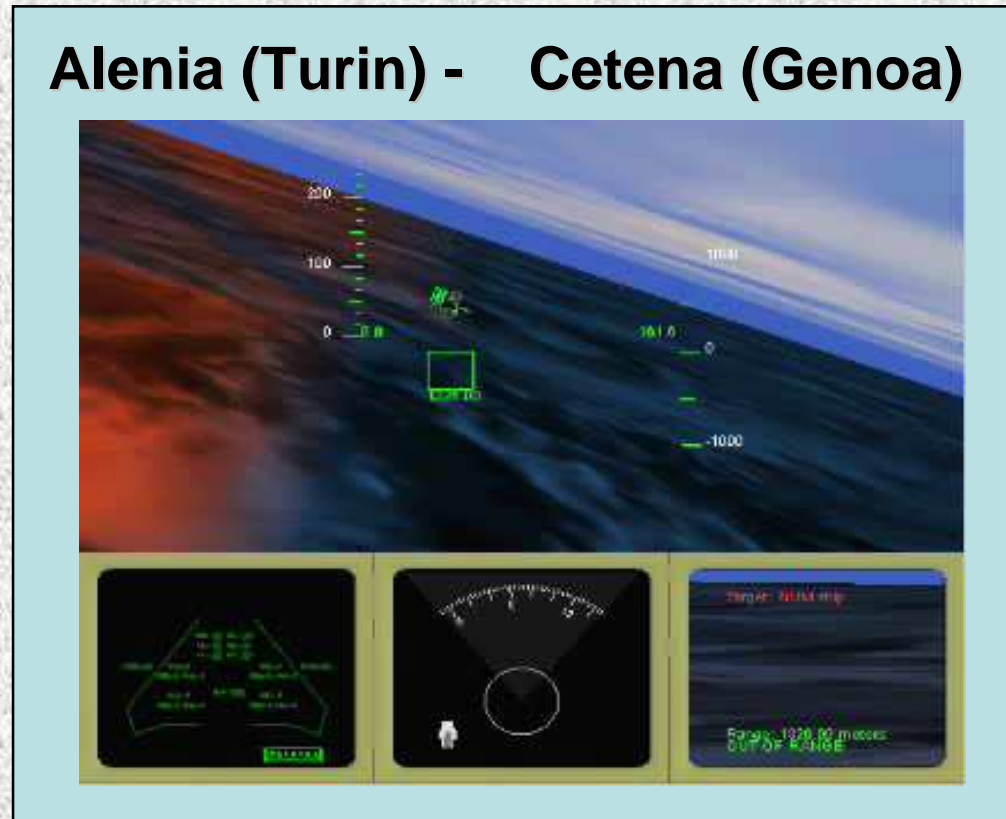
Port traffic



Operational scenarios assessment

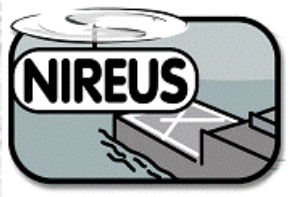
Geographically Distributed HLA Federations

Alenia (Turin) - Cetena (Genoa)



Interoperability study of geographically distant aircraft simulator and a ship simulation using a standard ISDN connection.

Operational scenarios assessment



International HLA Federation Development

Helicopter take-off and landing operation of on a frigate



Operational scenarios assessment

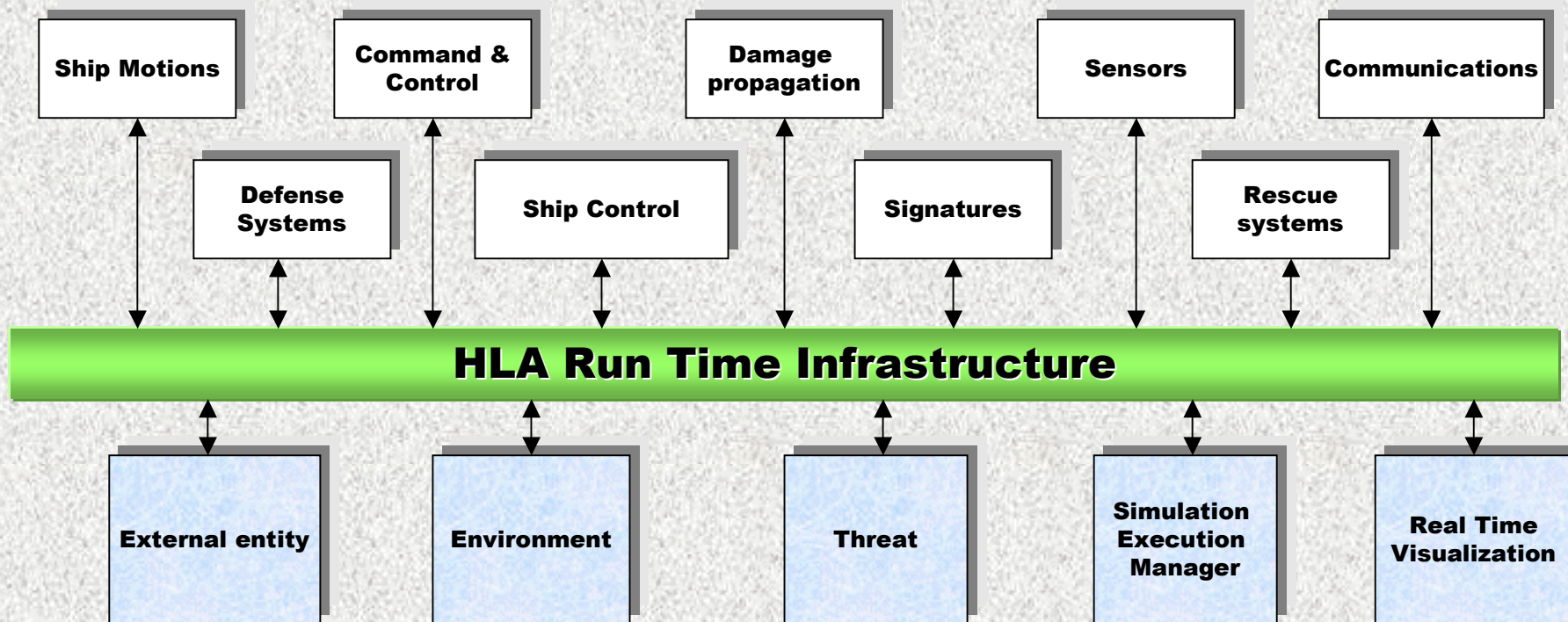



Orizzonte Sistemi Navali

- An integrated simulation architecture for the analysis and evaluation of operative effectiveness of naval ships
- A synthetic environment for the study of the behaviour of the ship in different operative scenarios
- A distributed naval scenario simulation to support military ship projects during entire life cycle to reduce costs, times and risks

Operational scenarios assessment

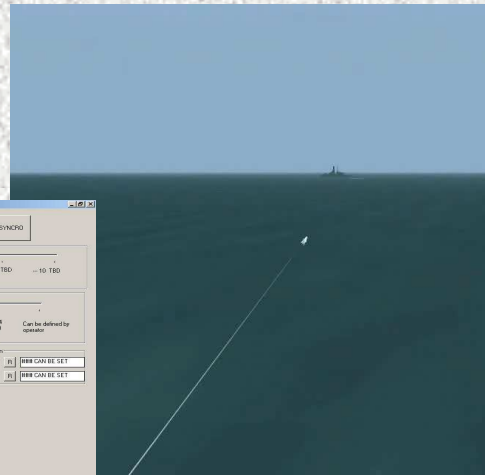
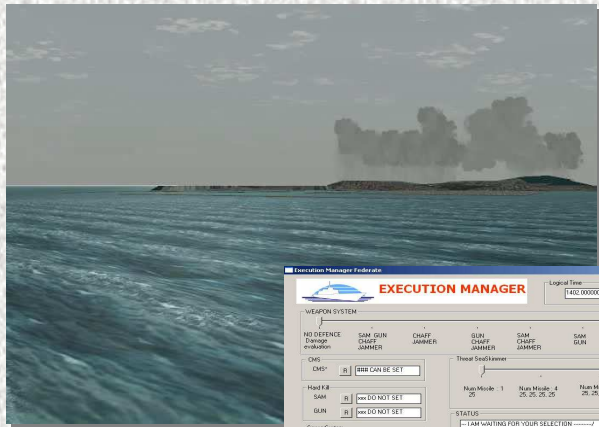
Architecture



Operational scenarios assessment

Approach

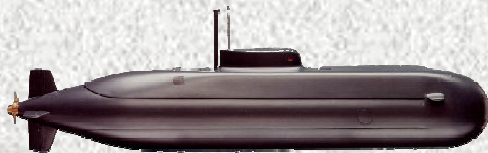
- ✓ HLA compliance for interoperability purposes and SW reuse
- ✓ Evolutionary environment development: federates & federations repository
- ✓ Use of COTS/GOTS
- ✓ Real time/ as-fast-as-possible/logical time simulations
- ✓ Interactive environment: Man in the loop



Operational scenarios assessment

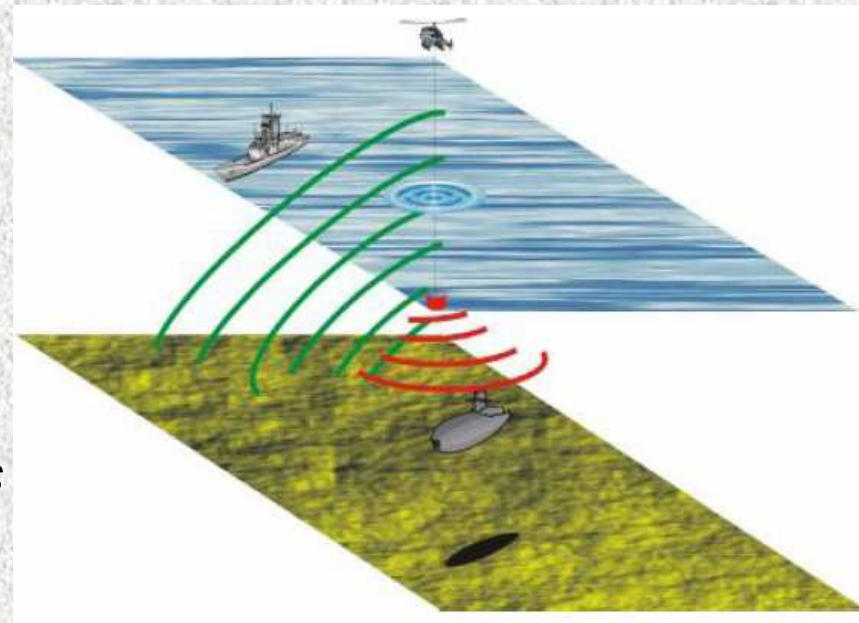
VISION HLA Federation

*The next release will integrate the underwater Warfare
(**UWIS UnderWater Information System**)*



Some necessary upgrades:

- *Submarine models*
- *Weapon Systems (torpedos)*
- *Sensors Systems (sonar)*
- *ECM: decoys, jammer, air bubbles*
- *C2 AAW- ASW*



Orizzonte Sistemi Navali

Operational scenarios assessment

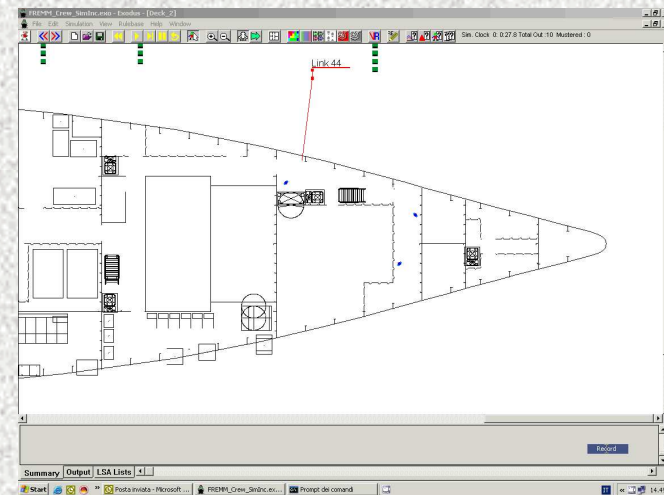
Introduction of Human behaviour in VISION

To simulate scheduled activities during full mission operation and to behave autonomously using Artificial Intelligence during crisis situations



Completely interactive and self adapting AI behaviour

Manikins with default activities scheduled



Operational scenarios assessment

ViSIR

Virtual Ship Integrated Architecture



Italian Navy



Operational scenarios assessment

Aim

To develop three simulation environments representing the following operations:

- Replenishment At Sea**
- Craft landing in the internal dock of a LPD Ship**
- VTOL vehicles operations on aircraft carrier**

Operational scenarios assessment

Replenishment at Sea



- To simulate Replenishment operations in open seas with different meteorological conditions
- To verify operation constraints (ships speed, distance...)
- To analyse different RAS devices in term of position, operative behaviour, efficiency etc.

Operational scenarios assessment

Landing Craft operations in a LPD Ship



- To simulate LCU behaviour inside the internal dock
- To evaluate feasibility of tank loading/unloading on the LCU
- To verify operation constraints (LPD ships speed, LCU characteristics...)
- To analyse different internal dock deck configurations

Operational scenarios assessment

VTOL operations on ship



- To simulate take-off and landing operations
- To evaluate feasibility of operations in different environmental conditions
- To take into account ship manoeuvring behaviour during operation

Future challenges

- Integration of real systems inside the federation
- Integration of other entities simulators
- Interaction among different experts
- Scalability: use in different design/operation steps
- Human in the loop and ergonomic assessment

Conclusions

- Simulation is generally used
- Interoperability and reuse of existing simulations can be achieved using HLA
- The final users is not yet enough confident in the results as should be
- Further standardization needed for broader reuse and integration among different organizations
- Reuse in different life cycle phases (training...)