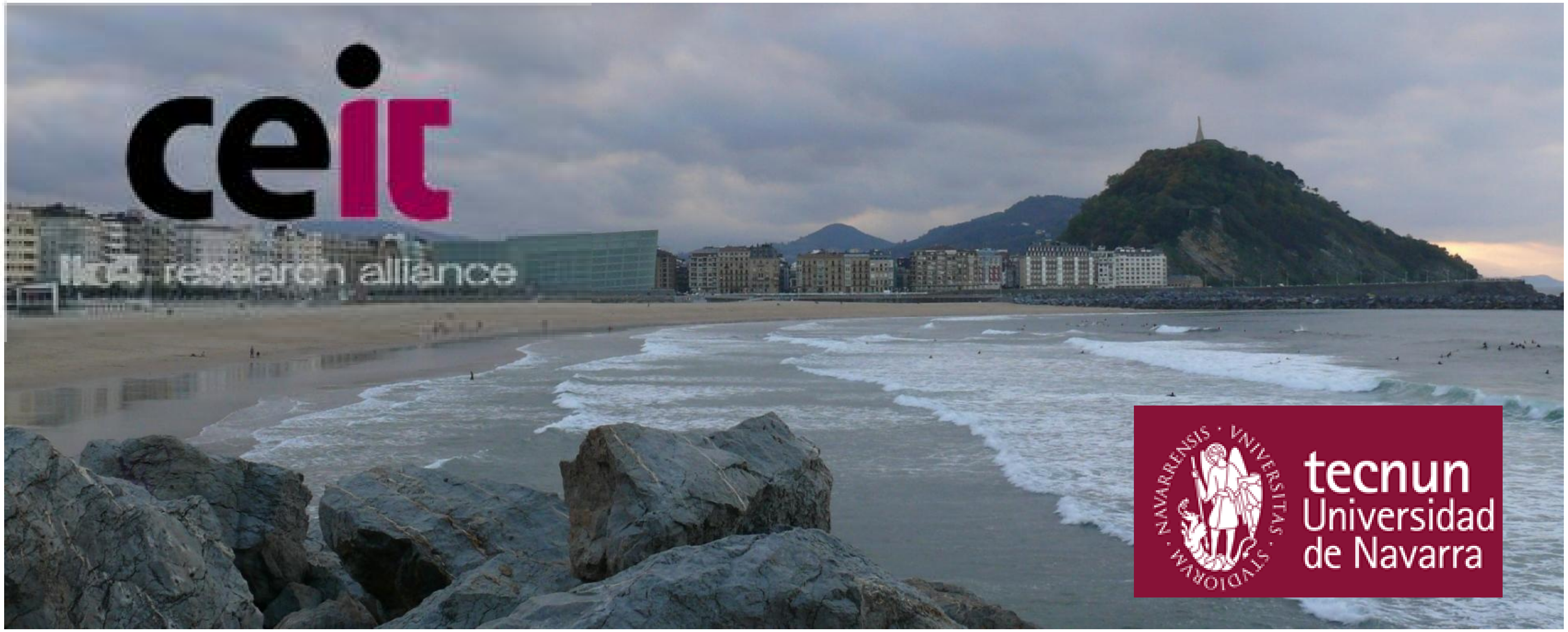


CEIT Simulation Unit

Diego Borro & Luis M. Matey (CEIT & Tecnun)

Eurographics 2013

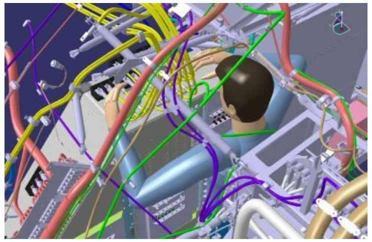
Lab Presentation

Introduction: CEIT

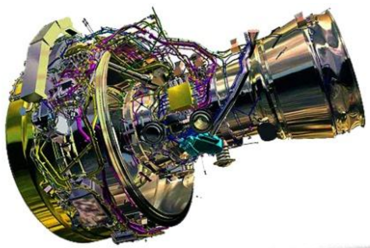
- Non-profit **Research Centre** created in1982
- Located in **San Sebastian**
- Development of **Applied Industrial Research**
- **Training** of young researchers
- Close Relationship with the **University of Navarra**
- Multidisciplinar Centre
- CEIT figures
  - Staff : >275
  - Budget: 17 M€
  - Thesis: 18 (aprox. per year)
  - International Conferences: 100 (aprox. per year)
  - Scientific Papers: 70 (aprox. per year)

CEIT Simulation Unit

- **Simulation**
  - Multibody
  - Mechanical Modelling, Multi-domain Modelling
- **Multimodal Interfaces**
  - MIXED REALITY:
    - Virtual Reality and Augmented Reality
    - High Performance Graphics Technologies
  - INTERFACES (Human-Computer Interaction) :
    - HCI (sensor integration, vision, etc)
    - Haptics: mech. design, control, coupling hardware/software
    - Recognition, understanding and animation of the human motion
  - COGNITIVE SYSTEMS: VR e-learning systems



- **ITS & Training Simulators**
- **Biomechanics**: Modelling and Simulation of Humans
- **Bioengineering**: Medical Imaging and Simulation

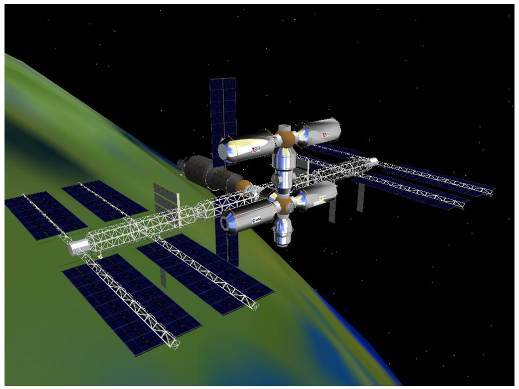


- **Spin-offs:**
  - STT Engineering & Systems (1998): Motion Capture & Image Analysis
  - LANDER Training & Simulation (2002): Training Simulators

Origin of CG, VR and AR at CEIT

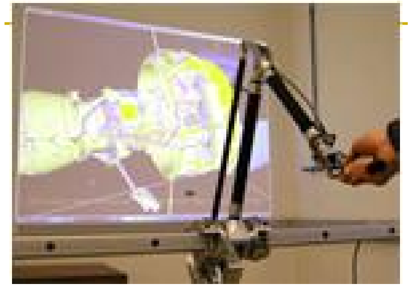
- Origin:
  - Convergence of Technologies:
    - Multibody Systems (80's)
    - Computer Graphics
    - Real Time techniques (Simulation, Interaction,…)
  - From Real Time Interactive Simulation to Virtual Reality through applications for European Space Agency (E.S.A.)

DYNAMAN 1989

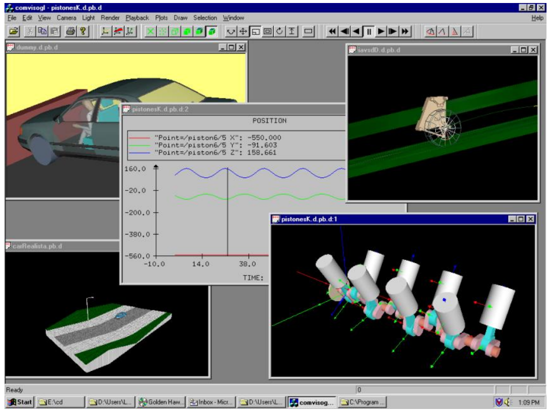


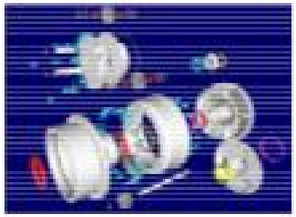
ISSA VR SIMulator 1995

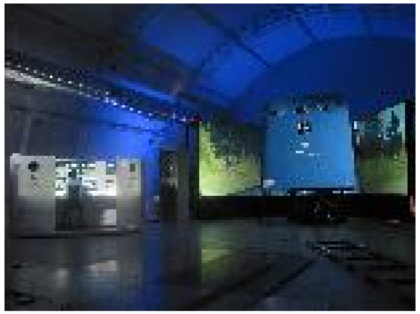
Evolution of tech. at CEIT Simulation Unit



AR & Multimodal Interfaces (00's)

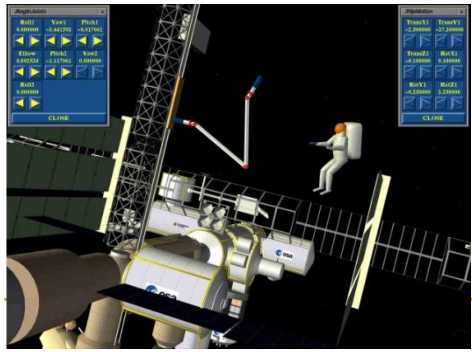


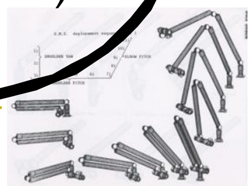




VR (90's)

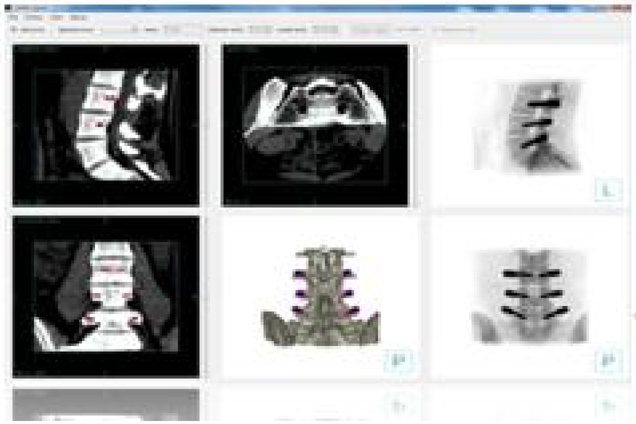
2D and 3D interactive Systems (80's)

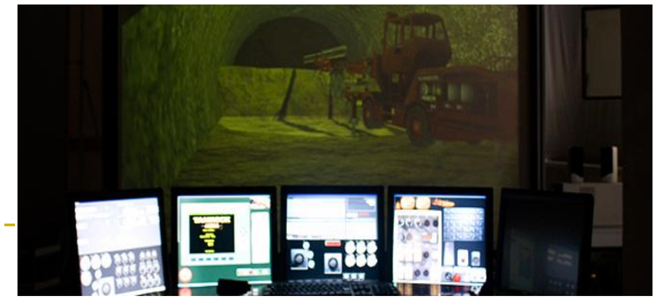




Focus Sectors of our VR/AR activity

- Industry
  - Aerospace
  - Aeronautics
  - Automobile
  - Machine Tool
  - Special Machinery
- Medicine
- Formation





Interactive 3D & AR/VR contributions

Simulators

Virtual Prototyping

Manufacturing Simulators

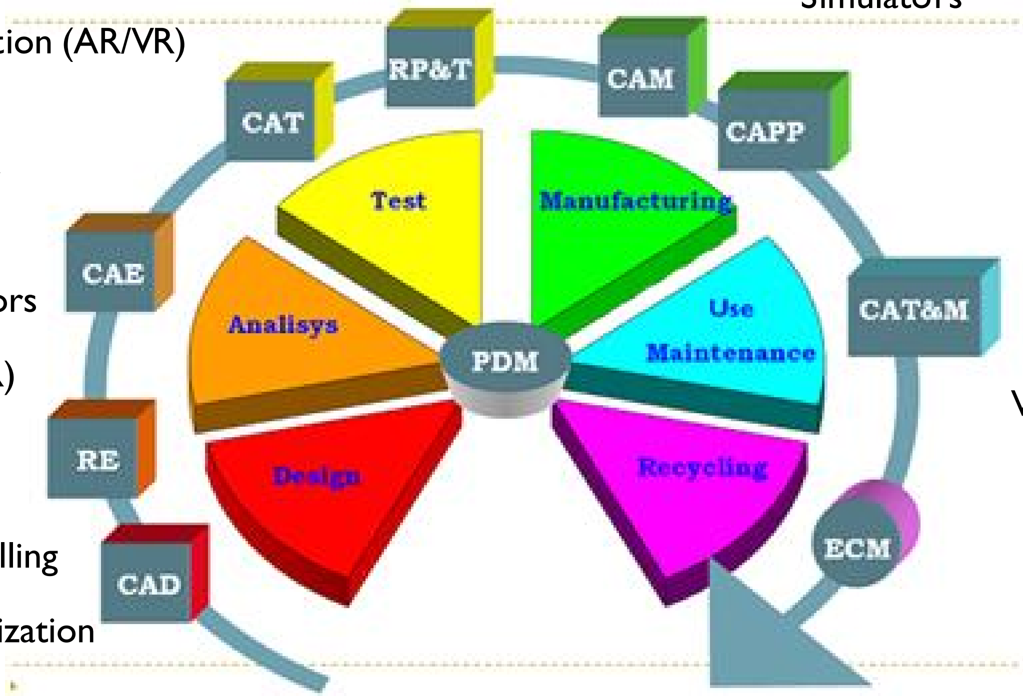
Design Verification (AR/VR)

Virtual Human Test

Assembly/Disassembly planning

Advance CAE Postprocessors

Model Inspection (AR/VR)



Virtual Modelling

Inmersive Visualization

Maintenance Tools (AR/VR)

Training Simulators

VR/AR Remote Assistance

Automatic Dissasembly Tools

Other Tools related to Customers (Marketing, etc)

Case Study: MR for maintainability at CEIT

- Virtual Reality + Haptics + MoCap ….
  - Interactive planning (Sequence & routes)
  - Accesibility Studies
  - Tool validation
  - Only CAD Models
- Automatic Path Planning
  - Automatic paths & precedence relations
- Augmented Reality
  - Real time Assistance
- Digital Humans
  - Ergonomics
- APP+AR+DH
  - Reduces data preparation: Industry oriented
- ……….

REVIMA Project

- **Develop a hardware/software environment** for the realistic simulation of **maintainability** and **accessibility** tasks
- Parts behaviour based on part semantics (screws, clips, etc)
- Use of **Virtual Reality** + **Force feedback** (**haptics**)
- **Very large** geometrical models (Aircraft Engines)
- Substitute physical by **digital mockups**

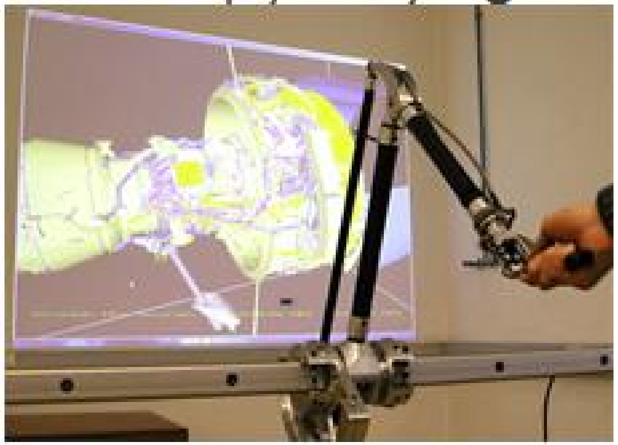
Haptic Characteristics:

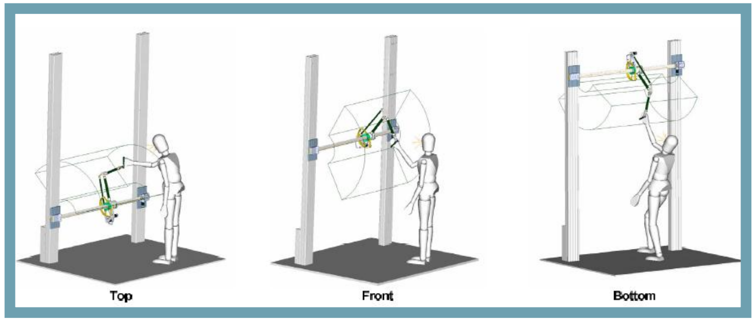
Large cylindrical workspace

Different configurations

Force feedback: Fx, Fy & Fz

6 DOFs measured

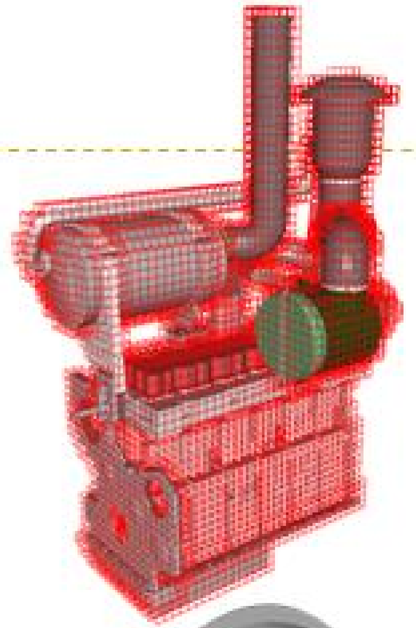




- D. Borro, J. Savall, A. Amundarain, J.J. Gil, A. García-Alonso and L. Matey, "*A Large Haptic Device for Aircraft Engines Maintainability*", **IEEE Computer Graphics & Applications**
- D. Borro, A. García-Alonso and L. Matey, "*Approximation of Optimal Voxel Size for Collision Detection in Maintainability Simulations within Massive Virtual Environments*", **Computer Graphics Forum**

Automatic Path Planning

- **Automatic generation of the sequence of removals** of part or subassemblies required to disassemble a target component from a product.
- Based on geometry of parts only (VRML)
- The proposed method can solve problems even if there is a degree of **geometrical uncertainty** due to tessellation.
- Can manage parts or subassemblies
- Two phases:
  - Extraction path detection (Translations or T-RRT: Targetless-Rapid growing Random Trees)
  - Precedence determination (Check which removed parts are obstacles in the extraction path)



- Aguinaga Iker, Borro Diego, Matey Luis, *"Path Planning Techniques for the Simulation of Disassembly Tasks"*, **Assembly Automation**
- Aguinaga Iker, Borro Diego, Matey Luis, *"Automatic selective disassembly and path planning for the simulation of maintenance operations"*, **IEEE Virtual Reality 2007**
- Aguinaga Iker, Borro Diego, Matey Luis, *"Parallel RRT-based path planning for selective disassembly planning"*, **International Journal of Advanced Manufacturing Technology**

AR Guidance for Maintenance: Monocular tracking based on untextured 3D models

- First camera pose problem
  - Markers (Environment adaptation) or Manual initialization (hard work)
- Tracking methods based on:
  - Markers or Textured models (a lot of features to track)

Our solution: **3D automatic recognition and tracking of untextured models**

- 3D recognition for the first **camera pose (**no markers, no manual work , tracking failure recovery)
- **Real time** tracking of **untextured models**
  - Hybrid tracking: points tracking + particle filter + edge tracking

- **Our new proposal: An automatic AR system for guiding and assistance in disassembly tasks** (Automatic disassembly planning+ Automatic 3D object recognition + Real time 3D tracking + AR disassembly instructions generation)

- Sánchez, J., Álvarez, H., and Borro, D., "*Towards Real time 3D Tracking and Reconstruction on a GPU using Monte Carlo Simulations*", **Proceedings of the 9th IEEE International Symposium on Mixed and Augmented Reality (ISMAR 2010)**
- Álvarez, H., Aguinaga, I., and Borro, D., "*Providing Guidance for Maintenance Operations Using Automatic Markerless Augmented Reality System*", *10th IEEE* ***International Symposium on Mixed and Augmented Reality (ISMAR 2011)***
- Álvarez, H., and Borro, D., "*Junction Assisted 3D Pose Retrieval of Untextured 3D Models in Monocular Images*", ***Computer Vision and Image Understanding*.2013**.

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EG2013

Lab Presentation

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