# Simulation Unit in CEIT

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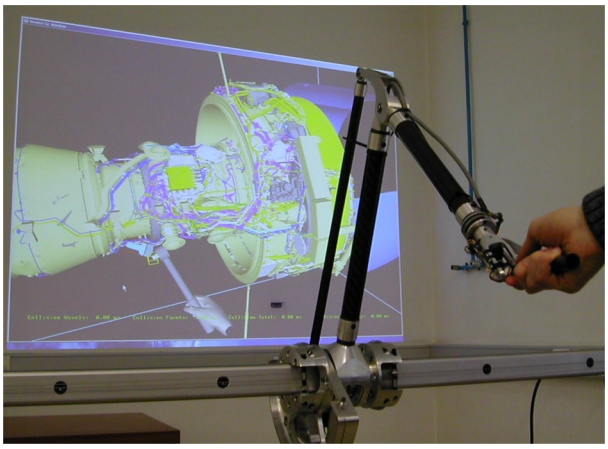

**Figure 1:** *REVIMA: a Virtual Reality system for maintainability tasks*

**Abstract**

*CEIT is a non-profit research center of the University of Navarra, Spain. The Simulation Unit has more than 20 years of experience combining traditional simulation techniques in Mechanical Engineering with the latest advances in ICT. Therefore, it achieves a wide variety of innovative applications, working along different but related research lines like mechanism analysis, design and optimization, simulation of multi domain systems, human motion reconstruction, VR/AR applications, human-machine interfaces, and haptics.*

## 1. Scientific introduction

The Unit is composed in three main research teams:

- Mixed reality and multimodal interfaces. This research field consists of applying human-computer interaction techniques in order to give rise to mixed reality and interactive applications. It covers virtual and augmented reality techniques, artificial vision and human-computer interaction. This team is in collaboration with another unit of CEIT (Experimental Dynamics Unit) so that the design and manufacture of new interfaces, as haptics, can be carried out.
- Simulators and ITS. Research is focused on activities related to physical systems modelling, i.e. the design, equations computation, time integration, software development, code optimization and its integration into more complex systems. Main applications are training simulators and intelligent transport systems.
- Biomechanics. Research is focused on biomechanics and its applications to road safety, ergonomics, medical science and new interfaces. The research consists basically of human body modelling and the interpretation, synthesis and animation of new human motion.

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## 2. Staff

The key people in the unit are:

- Aiert Amundarain (Electric Engineer, PhD)
- Iker Aguinaga (Industrial Engineer, PhD)
- Hugo Álvarez (Computer Science, PhD)
- Sergio Ausejo (Industrial Engineer, PhD)
- Ainara Bilbao (Electronic Engineer, PhD)
- Diego Borro (Head of the Unit, Computer Science PhD)
- Alfonso Brazález (Physics Science, PhD)
- Juan Tomás Celigüeta (Mechanical Engineer, PhD)
- Alberto Lozano (Computer Science, PhD)
- Luis Matey (Mechanical Engineer, PhD)
- Ángel Suescun (Mechanical Engineer, PhD)

## 3. Facilities

The Unit has several labs with special facilities as the following:

- Robotics lab:
  - 1 interface haptic Phanthom 3-dof (Sensable)
  - 1 interface haptic Phanthom 6-dof (Sensable)
  - 3 interfaces haptics Omni (Sensable)
  - 2 haptic interfaces LHIfAM (own development)
  - 2 Frontal passive stereosystem (Christie LX20)
  - 1 industrial Mitsubishi robot PA-10 (7dof)
- Simulators lab:
  - Bus-Truck Training Simulator with a Moog 6DoF platform
  - Train-Subway Training Simulator
  - Inmersive Stereoscopic walls
- Multimodal lab:
  - ImpulseSystem (Phasespace) mocap
  - Vision-based markerless Mocap system (own development)
  - 2 Frontal passive stereosystem (Christie LX20)
  - n-Vision Helmet Mounted Display
  - 1 dataglobe VTI CyberTouch, 15 dof and 6 actuators (vibrators)
  - 2 Flock of Birds

## 4. Collaborations

Some important recent industrial partners are: Airbus Military, ITP, Orbea, Inta, Indra, Lander Training and Simulation, General Cable, Egile, Alsa, Renfe, Metro Bilbao, Sener.

## 5. Projects

The unit has been actively participating in various projects through the last 5 years, being part of 11 regional projects, 11 national projects and 5 projects from the European Union. Some examples are:

- SUN (Assembly guided system based on augmented reality). Supported by EADS-CASA.
- SKILLS (Multimodal Interfaces for Capturing and Transfer of Skill). Supported by IST-FP6 European Union (IP).
- FRESH (FRom Electric cabling plans to Simulation Help). Supported by the IST-FP6 European Union (Strep).
- DHERGO (Digital Humans for Ergonomic Design of Products). Supported by the IST-FP7 European Union (IP).
- INTRASIM (Intelligent Training Simulator). Supported by Lander Training and Simulation.
- HASISTEC (Assistance tools for surgery). Supported by Centro de Bioingeniería, Universidad de Navarra.
- CABINTEC (Smart Cabin Road Transport). Supported by Science and Technology Ministry (PSE).

## 6. Publications

The activity of the unit results in quality publications in the last 10 years (22 PhD theses, 11 books, 40 journal articles and 117 conference contributions). Some examples are:


- San-Vicente, G., Aguinaga, I., Celigüeta, J.T., "Cubical Mass-Spring Model design based on a tensile deformation test and nonlinear material model", IEEE Transactions on Visualization and Computer Graphics, Vol. 18, No. 2, pp. 228-241. February 2012.
- Fierz, B., Spillmann, J., Aguinaga, I., and Harders, M., "Maintaining Large Time Steps in Explicit Finite Element Simulations Using Shape Matching", IEEE Transactions on Visualization and Computer Graphics, Vol. 18, No. 5, pp. 717-728. May 2012.
- Bilbao, A., Brazález, A., García, I., Tybel M., and Aguiriano N., "Virtual Instrument Cluster for enhancing the configurability of an automotive simulator", Simulation: Transactions of the Society of Modeling and Simulation International, Vol. 88, No. 8, pp. 957-971. August 2012.
- Velez, G., Matey, L., Amundarain, A., Suescun, A., and Marín, J.A., "Modeling of Shotcrete Application for Use in a Real-Time Training Simulator", Computer-Aided Civil and Infrastructure Engineering. October 2012.
- Ausejo, S., Suescun, A., and Celigüeta, J.T., "An Optimization Method for Overdetermined Kinematic Problems Formulated with Natural Coordinates", Multibody System Dynamics, Vol. 26, No. 4, pp. 397-410. 2011.
- Álvarez, H., Aguinaga, I., and Borro, D., "Providing Guidance for Maintenance Operations Using Automatic Markerless Augmented Reality System", Proceedings of the 10th IEEE International Symposium on Mixed and Augmented Reality (ISMAR 2011), pp. 181-190. Basel, Switzerland. October 26-29, 2011.
- 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), pp. 185-192. Coex, Seoul, Korea. October 13-16, 2010.