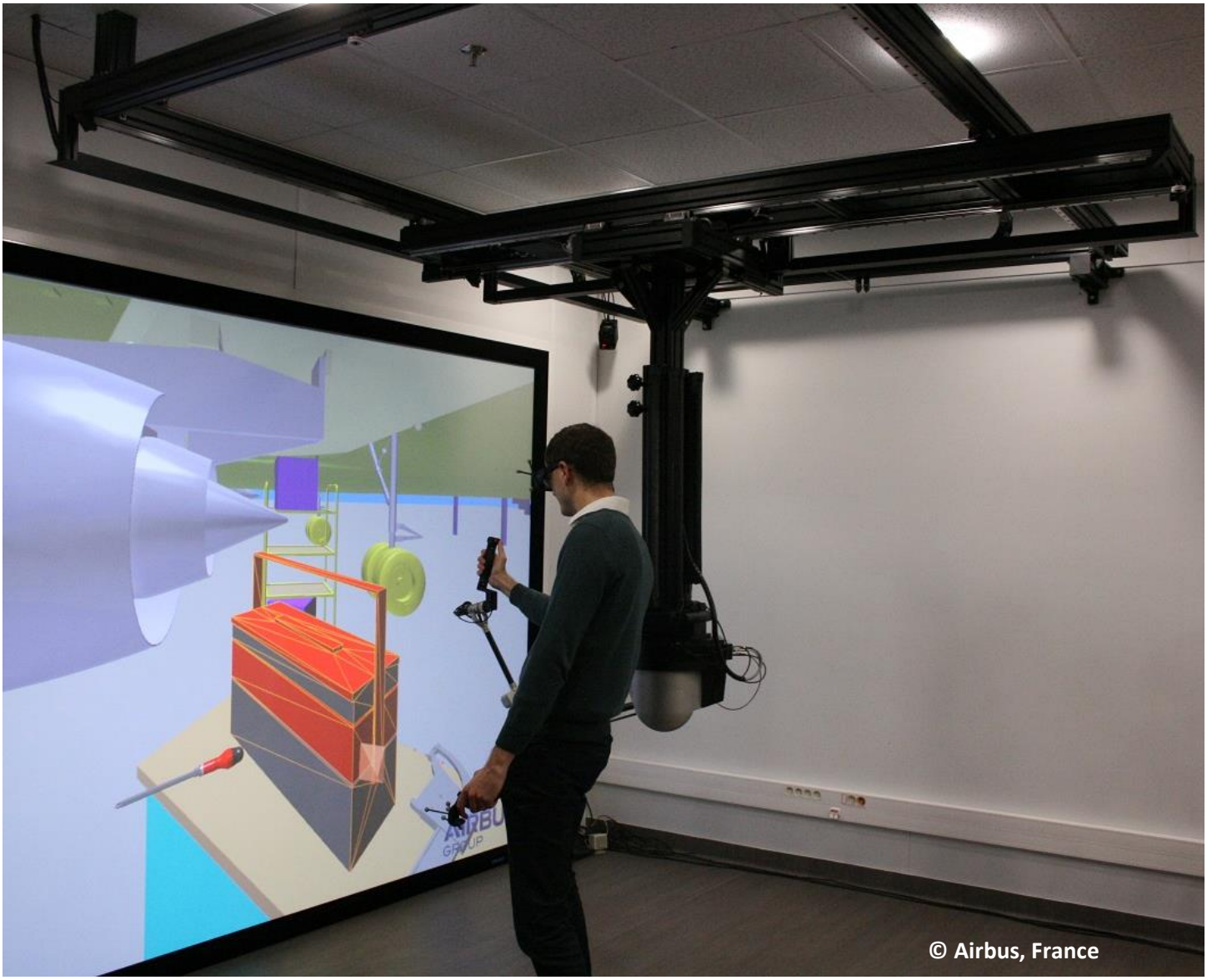
haption

TECH BRIEF

INTERACTIVE ASSEMBLY SIMULATION



MOTIVATION

Assembly Process Planning is a very important task in the development of a new industrial product. If not done properly, it can lead to extremely high added costs, resulting from the impossibility to integrate components according to the prescribed assembly procedure. Typical problems are: insufficient room for moving a component to its intended position; screws not reachable with the prescribed tool; not enough visibility for the operator to ensure the quality of the assembly; etc.

The same considerations hold for maintenance procedures, with even more acuteness: in order to reduce maintenance costs, the number of components which the operator needs to disassemble and reassemble should be minimized. As a consequence, space tends to be restricted and overcrowded by other pieces of equipement, limiting the access paths for the component to be changed as well as for the tools.

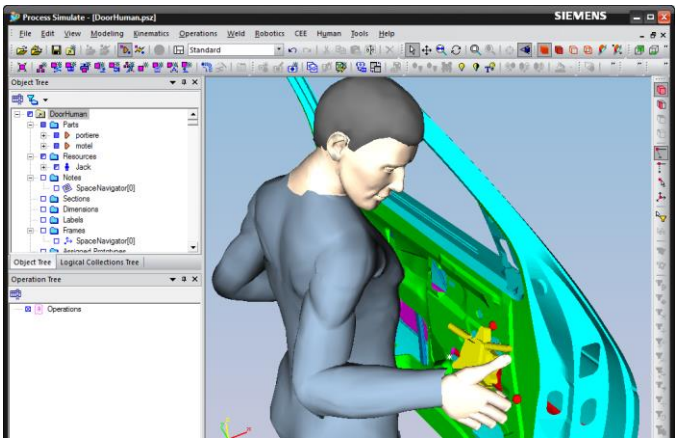
Throughout the product development process, the assembly or maintenance procedures need to be verified for coherence with the current state of design of the product. The verification can be done with real prototypes or with virtual models. But in the early phases, no physical parts exist which can be manipulated to validate assembly tasks, only the virtual model can be used.

SOLUTION

In many cases, the feasibility of the assembly cannot be decided on a simple visual inspection of the 3D model, and more complex investigations are needed. Interactive simulation with haptic feedback recreates a physical interaction with the 3D model, calling upon the cognitive capabilities and understanding of spatial relationships of the user. Through the haptic interaction, the user can make full use of his manual skills, in order to identify bottlenecks, evaluate clearance and explore possible improvements.

By performing the assembly operations “hands-on”, the design engineer or the process planner measures the complexity and evaluates also the ergonomic dimension of the tasks. It reproduces the same kind of physical experience as can provided by a real prototype. As a consequence, it is also available to people with no expertise in CAD, such as ergonomists and senior assembly operators.

In order to simplify the implementation of interactive assembly simulation, Haption provides turn-key solutions and plug-ins for existing CAD/PLM platforms. Currently supported are Catia/Delmia V5™, 3DEXPERIENCE™ and Solidworks™ by Dassault Systemes, Jack™ and Tecnomatix Process Simulate™ (picture below) by Siemens PLM. For a complete list of supported software, please refer to the webpage www.haption.com, under “Products/Software”.



USE CASES

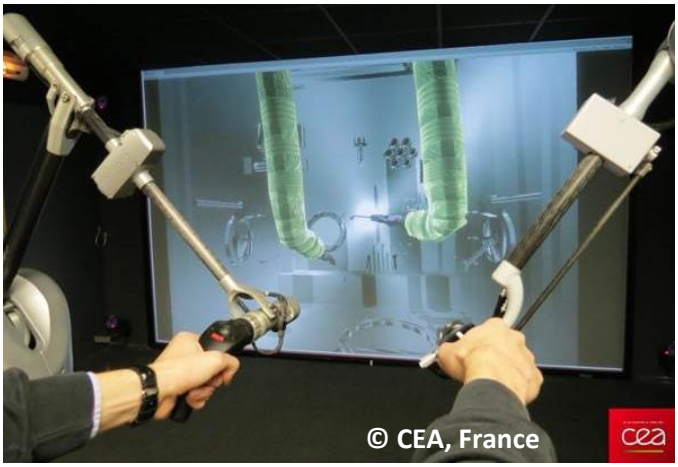
Interactive assembly simulation is used in the **automotive industry** mostly for the validation of initial assembly operations. Typical assembly scenarios are the car doors (including the windows), the seats, the steering column, the spare tire. The reachability for tools such as screw guns is also a major issue. Complex load handling devices can be modelled as kinematic chains and integrated into the simulation.

In the **aerospace industry**, the same technique is used mainly for the validation of maintenance operations. Typical use cases are fuel lines, air conditioning hoses, fuel injectors, electric switchboards, hydraulic actuators, etc. It is often necessary to include an avatar of the human operator inside the simulation, so that the accessibility of the maintenance spots can be verified.

In the **nuclear industry**, the simulations usually include tele-robotic equipment.

Other use cases are found in heavy equipment industries like shipbuilding, trains, agriculture and field machinery, off-shore and defence.

Every time the construction of a physical prototype means high costs and long delays, interactive assembly simulation makes sense.



CUSTOMER TESTIMONIES

David Defianas, Virtual Reality Expert, PSA Peugeot Citroën, France:
"We're using Haption force-feedback devices at our sites of Velizy and Sochaux. We simulate with them roughly 130 assembly processes a year. The investment has long paid off."
[Source: Interview @ Laval Virtual Conference, France, 2013]

Michael Torok, VP & Chief Engineer for Marine Corps programs, Sikorsky Aircraft Corp, USA:
"We uncovered a handful of fuel lines that required modifications because the parts would not fit into the aircraft as original designed, or would have been damaged upon installation. We've estimated savings of about 18 million dollars for this one event alone."
[Source: Press Release "Sikorsky Today", January 17, 2011]

FURTHER READING

⇒ Tching, L. and Dumont, G. (2008), “Interactive simulation based on non-smooth contact dynamics: Application to haptic rigid-body simulations”, Virtual Concept & IDMME 2008, 9 pages, October 2008.

⇒ Ferrise, F., Bordegoni, M., and Lizaranzu, J. (2010), “Product design review application based on a vision/sound/haptic interface”. In Haptic and Audio Interaction Design, R. Nordahl, S. Serafin, F. Fontana, and S. Brewster, eds., Vol. 6306 of Lecture Notes in Computer Science. Springer Berlin / Heidelberg, pp. 169–178.

⇒ Seth, A., Vance, J. M. and Oliver, J. H. (2010), “Combining dynamic modeling with geometric constraint management to support low clearance virtual manual assembly tasks”, ASME Journal of Mechanical Design, 132(8), 2010.

⇒ Vance, J. M. and Dumont, G. (2011), “A Conceptual Framework to Support Natural Interaction for Virtual Assembly Tasks”, Proceedings of the ASME World Conference on Innovative Virtual Reality (WINVR2011), Milan, Italy, 27-29 June 2011, 6p.

⇒ Perret, J., Kneschke, C., Vance, J. M. and Dumont, G. (2013), “Interactive Assembly Simulation with Haptic Feedback”, Assembly Automation, Volume 33, Issue 3, April 2013.

⇒ Bönig, J., Perret, J., Fischer, C., Weckend, H., Döbereiner, F. and Franke, J., “Creating realistic human model motion by hybrid motion capturing interfaced with the digital environment”. Flexible Automation and Intelligent Manufacturing (FAIM 2014), San Antonio, Texas, USA

⇒ Leon, J.C., Chardonnet, J.R., Dupeux, T. and Perret, J., “An add-on device to perform dexterous grasping tasks with a haptic feedback system”. IDETC/CIE 2015, August 2-5, 2015, Boston, MA, USA.

ABOUT HAPTION

The company Haption was founded in 2001, as a spin-off of the French Atomic Energy Commission CEA. Resolutely product-oriented and independent, it provides hardware and software solutions based on haptics and force-feedback.

The main facility is located near Laval, France. In January 2013, a subsidiary was opened in Aachen, Germany. Haption products are available worldwide through partners and resellers.

Reference customers: ADA (IN), ADD (KO), Airbus (FR/GB/DE), Alstom Transport (ES), AREVA (FR/DE), AVIC (CN), Beihang University (PRC), BOEING (USA), BMW (DE), Daihatsu (JP), Daimler (DE), Dassault Aviation (FR), DIFFER (NL), Iowa State University (USA), IIT (IT), KIT (DE), Lockheed Martin (USA), Mitsubishi Motors (JP), NASA (USA), Politecnico di Milano (IT), PSA Peugeot Citroën (FR), Renault (FR), Sikorsky (USA), Thales Alenia Space (IT), Toyota (JP), United Space Alliance (USA), Volkswagen (DE)

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