

## **WELCOME TO THE WORLD OF HAPTICS FOR INDUSTRIAL APPLICATIONS**

Firstly, what is "Haptics"? This term means "of or relating to the sense of touch". Haptic technology, or haptics, refers to the technology that connects the user to a computerized system via the sense of touch by applying forces, vibrations and/or motions to the user. Perhaps people do not realize it, but haptic technology is already in our lives. Vibrating phones, gaming controllers and force-feedback control knobs in cars, like BMW's iDrive, are examples of this technology. These days, you can turn your phone ring tone off, put it in your purse and still feel that someone is calling you when you get a vibration. On the other hand, the Nintendo Wii video game console has been a new revolution for game lovers. The controller, called Wii, provides vibrations (i.e. when you hit the ball in a tennis game) which enhances the virtual sensation.

However, these examples are only the beginning of a cutting-edge technology. In terms of user-computer interaction, touch offers a new way of interacting or manipulating our screen. We used to just have vision and sound, now we also have touch. Thanks to haptic devices, such as, the most well-known PHANTOM haptic devices (Figure 1.a and a.b) or hand exoskeleton devices (Figure 1.c), "you can feel or touch what you see", recognize object shapes, textures, stiffness or grasp them and feeling their weight. Such devices are being used now for virtual modeling, medicine, education, assistive technology for blind people, as well as industrial design and maintenance. Our work addresses the industrial field.

Currently, physical prototypes are replaced by virtual or digital prototypes/models (Computer Aided Design - CAD) to avoid building expensive prototypes, especially in the automotive and aeronautics sectors (Figure 2.a). Increasingly, these CAD systems also allow designers and engineers to carry out assembly processes. The use of touch in CAD systems allows operators to feel forces and local stimuli similar to those in real situations, which provides more intuitive manipulation (i.e. check any defect or decide the most appropriate assembly sequence). On the other hand, different designers, which may be situated over a thousand kilometers away, often collaborate in the design and revision of products to lessen time and lower costs. The objective of this thesis is to research and provide solutions for collaborative haptic assembly systems, where several designers in different locations can grasp virtual parts and assemble them into a digital engine or other mechanical parts (Figure 2.b). To achieve it, a Collaborative Haptic Assembly Simulator, called CHAS, was developed, where two designers can collaborate together in real-time. Trials between Labein (Derio, Bizkaia) and Queen's University Belfast (Northern Ireland) have verified this system. When performing the assembly task, the operator in Bizkaia could assemble a part into another part grasped by the remote operator in Belfast. Furthermore, the operator in Belfast could feel the collisions with the part grasped by the remote operator.

This is a small step towards new systems of collaboration over the Internet, or a new way of interacting over distance. Doctors will have the ability to remotely diagnose and operate on patients, or we will be able to shake hands virtually. Greetings from Canada, where I am trying to overcome those challenges.