French Atomic Energy Commission chose Vortex for rich toolset and ease of use.

The Customer

The Laboratory of Technologies and Systems Integration of the Atomic Energy Commission (CEA/LIST) is a public institution based in France, with a mandate to develop technologies and provide specific solutions as relates historically to the nuclear industry.

The Project

Design a remote operated system for the inspection of nuclear hot cells.
Robotic systems and remote operation are of strategic importance to the nuclear industry. A remotely operated robotic system can enable operators to clean and even dismantle nuclear installations, while limiting radiation doses and danger to personnel.

The Challenge

Develop a robot arm carrier with accurate high level control.
Nuclear hot cells provide limited space and thereby reduce the amount of movement a robotic system can have within that environment. An operator requires precise control over the motion of the arm to accurately operate the system and perform a given task. Standard kinematic control methods are not suitable for operating the robotic arm, because they don't provide collision detection and dynamic avoidance of obstacles.

The Solution

Vortex real-time numerical solver to perform collision and dynamics calculations.
Vortex' powerful physics libraries provided collision and dynamics data about the virtual system, enabling the operator to generate trajectories in real time and properly manoeuvre the arm within the limited space. CEA took advantage of the rich set of joint and collision types in the design of the system, and used collision data to develop mechanism that would provide the appropriate controls at high level supervision.

The robotic arm developed by CEA consists of five sections. Each section is approximately one meter in length. Using Vortex joint types, each section is connected by a series of joints that allow for two degrees of freedom: each section is able to rotate from -90° to +90° in the horizontal plane, and from -45° to +45° in the vertical plane. A prismatic joint was added to the start of the arm, providing one additional degree of freedom, and is used to drive the motion of the arm into and out of the cell. Using a 3D Space Mouse, the operator is able to add a force to the far end effector of the arm, so that the induced vector speed is reflective of the user inputs.

The collision and dynamics data make it possible to generate a safe trajectory around the obstacles in the virtual environment scene. The operator can take advantage of the contacts between the virtual arm and the virtual environment, causing the robot to maintain proper, bounded trajectories'for example, for the inspection of a pipe, the head of the virtual arm is able to slide along the virtual representation.

In this development, CEA linked the collision and dynamics libraries into a supervision module, from where the operator drives the system. For a reliable simulator, there can be no margin of error between the 3D CAD simulation and the actual arm, CEA benefited from the accuracy of the Vortex solvers.

CEA plans to use Vortex in the design and implementation of numerous projects involving haptics and force feedback devices.

"Due to the development requirements of the project, we quickly focused on Vortex. It was easy to install and we were able to start developing right away".
Laurent Chodorge, CEA project engineer.

Vortex Product Advantages

- Ability to work within existing development environment (Visual C++, on Windows 2000)
- Rich set of joints and controller types
- Easy installation
- Reusable development

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