The Haptic Librarian: Enabling variable object assignment in large distributed haptic simulations

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***Abstract*— This article is an update on a proposed new way to manage several users across multiple machines to interact collaboratively in a complex simulation of a physical world. A key concept is the management of entities or objects in a distributed physics environment so a haptic librarian is proposed to ensure computational goals necessary for haptic rendering can be achieved.**

I. Introduction

Distributing the task of computing physical interactions in a haptic simulation will enable faster rendering of complex scenes, more flexibility in the rendering architecture and the opportunity to use multiple computers allowing for multiple collaborating users [1].

In haptics it is commonly held that a refresh rate of at least 1kHz is needed for stability [2]. However, large, complex simulation environments, using a single physics engine, result in lower refresh rates. Fig. 1 shows the median refresh rate of a simulation where objects not used in haptic rendering are handled by a secondary physics loop.

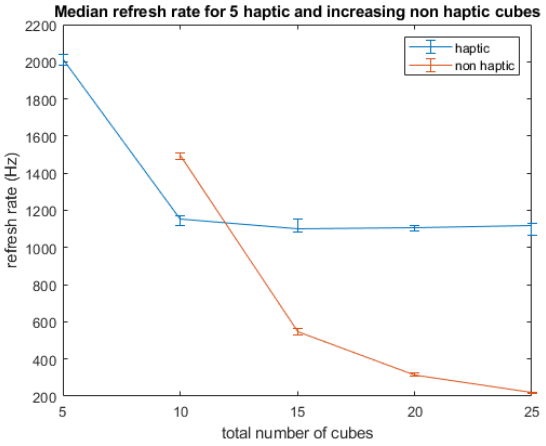

Fig. 1. Graph displaying the median refresh rates of a single process, multi-threaded haptic simulation comprising of two identical physics engines, one for haptic physics and one for non haptic. The haptic physics handled five cubes and one haptic device, the non haptic physics handled between zero and twenty cubes in increments of five.

This method allows the control loop of any haptic devices to work at high speeds while the graphical physics and rendering can occur elsewhere at lower speeds, which should reduce the impact the number of objects being simulated has on the system delay and stability. It is theorised that using a "Librarian" that uses directional bounding boxes based on the connected haptic devices states, should allow for stable switching of objects between control loops.

II. The Haptic Librarian

The haptic librarian is an object handling program designed to run as a server connecting to various physics simulations, both haptic and non haptic, using the ZeroMQ messaging library [3]. The librarian receives the state of a connected device and assigns objects to be managed by each physics engine.

A broad phase collision method (the Axis Aligned Bounding Box (AABB) algorithm) was chosen to provide the librarian these assignment capabilities [1].

A. Directional AABB's

To determine which objects the haptic cursor might collide with in the subsequent iterations the AABB's shape needed to be determined by the cursors velocity in addition to it's shape (see Fig. 2). As such this method is referred to as Directional AABB (DAABB).

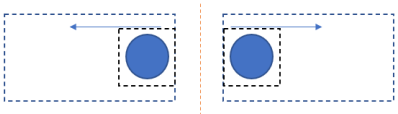

Fig. 2. The directional bounding box method, where the size of the bounding box is modified by the velocity of haptic cursor (Blue arrow). Planar movement increases the size of the bounding box in the axis perpendicular to the direction of movement to account for sudden changes in direction.

III. Future Work

Work is currently progressing on creating and testing the haptic librarian to determine if it is a viable method for ensuring system stability in large haptic simulations.

References

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