cChai3D: CHAI3D+Unity3D made easy

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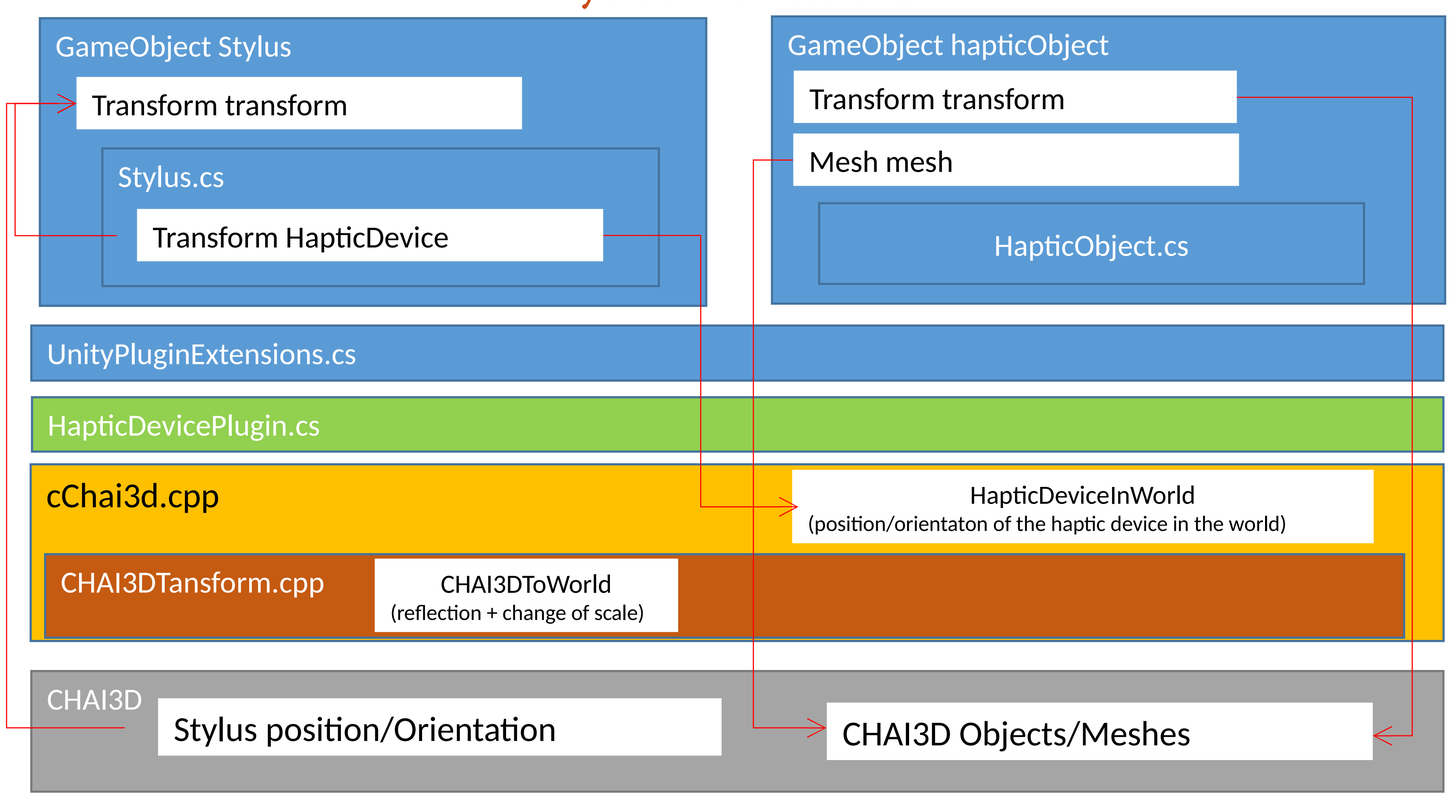
1 cChai3d Plugin Architecture

Layered Architecture



CHAI3D

CHAI3D [3] is a powerful open-source cross-platform C++ simulation framework for haptic applications. It integrates graphical rendering (OpenGL) and physical simulation engines to develop full-fledged virtual reality applications.

Unity3D

General-purpose game developers tend to prefer other alternatives that offer features such as state machines, animation support, and Graphical User Interfaces (GUIs) that simplify the development of games. Unity3D is one of those. It supports C# scripting.

Integration

We wrote cChai3d, a C wrapper around a lightweight version of CHAI3D that includes the force-rendering algorithms only. The C bindings facilitate its integration with any programming language and framework. It runs an high-frequency thread that handles all haptic rendering computations. We provide a generic C# wrapper, and scripts that helps integrating it with Unity3D.

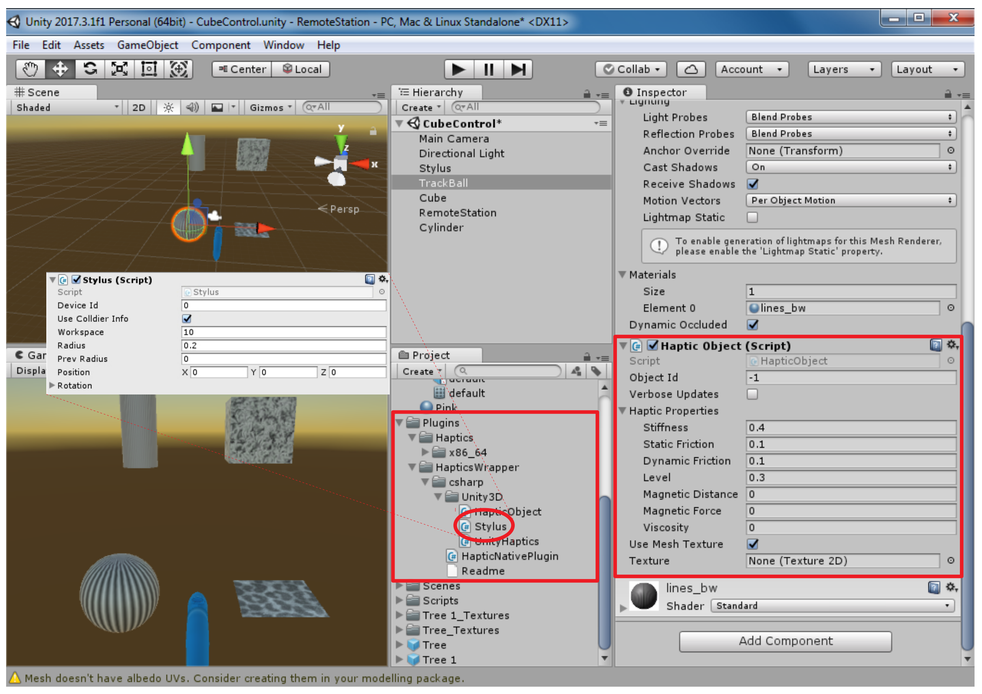
2 Plugin Usage – Unity3D

Easily add haptics to existing games:

- Drag-and-drop provided scripts to objects to enable haptic rendering
- Change haptic properties from the GUI
- Use mesh textures
- Independent control of visual and haptic rendering of textures
- Set haptic workspace size
- Set haptic handler size
- Set position and orientation of haptic workspace in game workspace

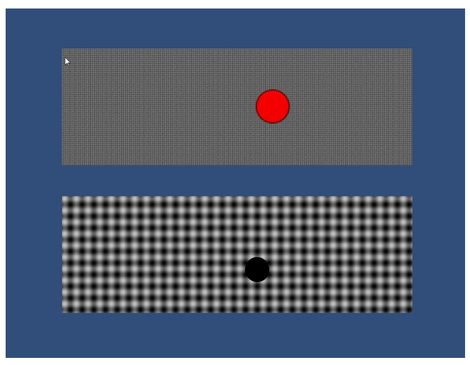
Scriptable:

- C# scriptable
- Simple API
- Access low-level haptic properties



3 Use Case Examples

- Experiment on Texture Perception [1]
- Task: Judge the similarity of 2 different haptic surfaces
- Different Textures
- Different values of
  - Stiffness
  - Dynamic Friction
  - Texture Level



The serious game controlled by an haptic device

Serious game[4, 2] inside the weDRAW European project[a]

Haptic device used to:

- Rotate the cube
- Explore its surfaces
- Find battery cells inside the cube
- Grab rocket parts
- Assemble the rocket

[a] https://wedraw.eu

3 References

[1] N. Balzarotti and G. Baud-Bovy. Effects of chai3d texture rendering parameters on texture perception. In *Eurohaptics*, submitted 2018.

[2] Gabriel Baud-Bovy and Nicolò Balzarotti. Using force-feedback devices in educational settings: A short review. In *Proceedings of the 1st ACM SIGCHI International Workshop on Multimodal Interaction for Education*, MIE 2017, pages 14–21, New York, NY, USA, 2017. ACM.

[3] F. Conti, F. Barbagli, R. Balaniuk, M. Halg, C. Lu, D. Morris, L. Sentis, J. Warren, O. Khatib, and K. Salisbury. The chai libraries. In *Proceedings of Eurohaptics 2003*, pages 496–500, Dublin, Ireland, 2003.

[4] Sam Duffy, Sara Price, Gualtiero Volpe, Paul Marshall, N Bianchi-Berthouze, Giulia Cappagli, Luigi Cuturi, Nicolo Balzarotti, David Trainor, and Monica Gori. Wedraw: using multisensory serious games to explore concepts in primary mathematics. In *Proceedings of the 13th international conference on technology in mathematics teaching*, volume 13. 13th International Conference on Technology in Mathematics Teaching (ICTMT 13), 2017.

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