Vizualization of spatiotemporal data in immersive VR

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Since the release of HTC Vive and Oculus Rift, immersive virtual reality (VR) has become widely accessible to the general public. Its main application is within the gaming industry, but it is also used in the fields of education, health care, construction, 3D design, and scientific visualization. In this project you will develop an application for interactive visualization of spatiotemporal data describing the evolution of reaction-diffusion systems in cells. For this project you will have access to HTC Vive VR equipment and the free version of Unity.

A cellular reaction network can be modeled at different scales. Specifically, we have simulators for hard sphere models (see Fig 1a), for grid based models (see Fig 1b), as well as for non-spatial models. Given a model, we can sample stochastic trajectories that give us information about the different molecules' positions over time. Typically we generate many such trajectories, from which we obtain interesting statistics.

Once a modeler has constructed a model and simulated it, the challenge is to make sense of the data produced in order to gain new biological insights. Immersive VR offers possibilities to visualize data efficiently. The purpose of this project is to develop tools that can aid researchers in understanding the behavior of their models in new ways. As an example, a typical use case would be to show 3D animations of a set of individual trajectories together with information about the average population counts. The user can grab a cell, turn it, move it, and start and stop a simulation.

This project will involve:

- Getting familiar with 3D design in Unity and C#-programming.
- Parsing mesh data as well as simulation data in CSV- or H5-format.
- Enable user interaction with model- and simulation results through the HTC Vive controllers.

There will also be plenty of opportunity to be creative, as the aesthetics of the visualizations is of some importance. The students will be encouraged to read relevant literature where these methods have been applied in modeling, and then contribute suggestions on how to improve the data processing with the possibilities of VR in mind.

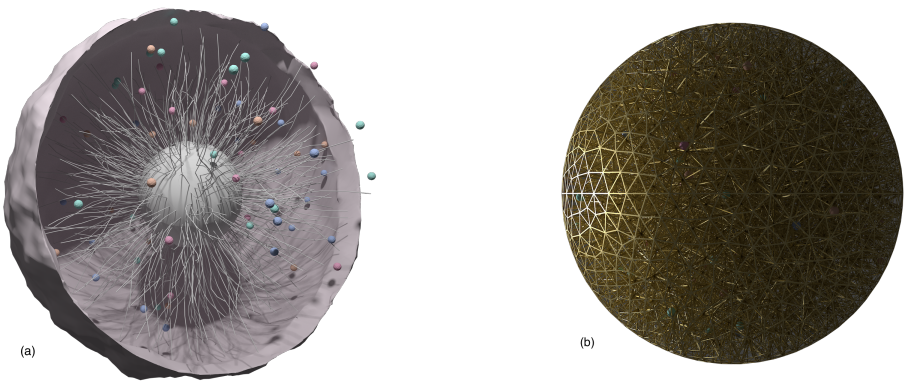

Figure 1: In (a) we illustrate a simulation of a hard-sphere model. The molecules diffuse and react with some probability upon collision. In (b) the molecules diffuse by discrete jumps on a mesh and react at some intensity once they occupy the same voxel.