# Visualization of spatiotemporal data in immersive virtual reality

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## Introduction

Visualizing simulation results of stochastic and discrete reaction-diffusion dynamics within biochemical networks is a challenging task. Here we explore immersive virtual reality to grant enhanced field of view, enabling the user to process more information.

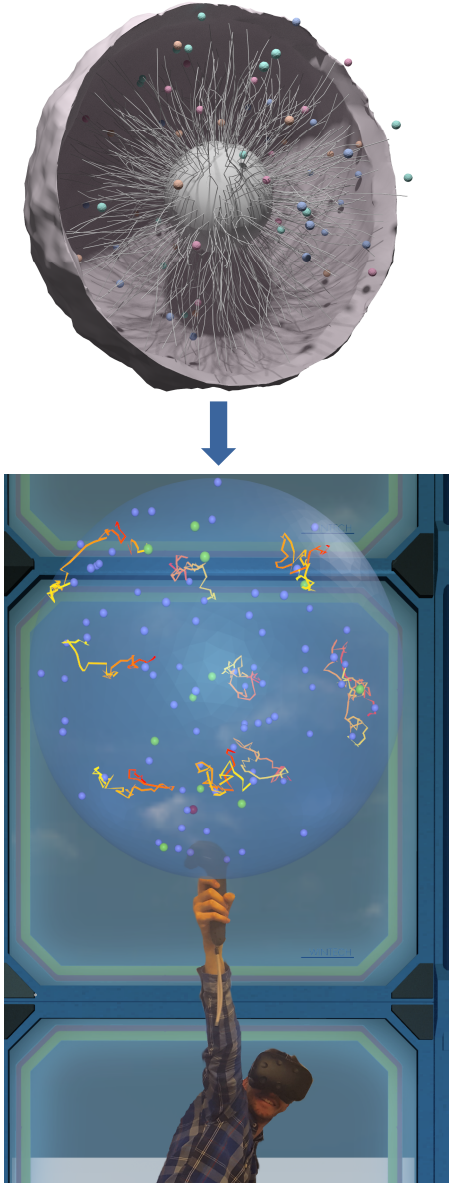
We have created an application that imports 3D position data over multiple time steps into an immersive and interactive virtual reality environment using the game engine Unity. The application is intended to be used with the HTC Vive headset.

## Implementation

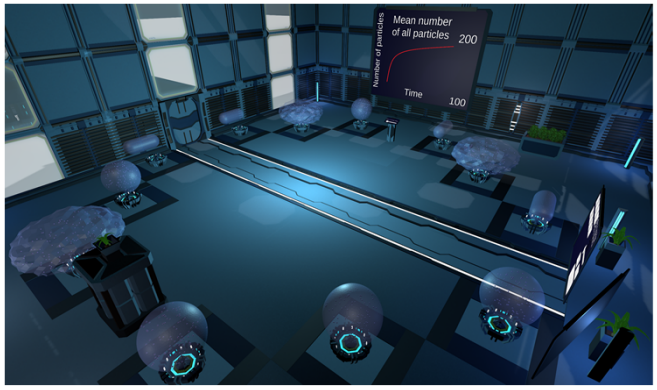
Unity uses a C# coding interface and simulation files are imported using an external Python script. Our application imports and processes raw simulation data and visualizes it directly. This results in a flexible and extensible approach when doing new simulations from the 3D world. New simulations can be generated from within the application where the simulator is hosted on the SNIC Science Cloud.

Unity offers plenty of opportunities for visualization and customization. From Unity's Asset Store we used *VRTK* for virtual reality interaction, *MeshChartFree* for the graphs, *TextMesh Pro* for the text and *Sci-Fi Styled Modular Pack* for the environments.

Download our program here (HTC Vive required):



Transition of a cell simulation into virtual reality




The modeling and simulation environment

## List of features

- Interactions with the cell geometries (grabbing and scaling)
- Generating new simulations on the fly using cloud computing resources
- Visualization of the trajectories from selected molecules
- Filtering molecules of a specific type
- Moving the simulations forward and backward in time
- Visuals indicating molecule reactions
- The simulations take place in a futuristic looking environment
- Graphs showing the number of molecules over time
- Import of custom cell geometries
- Multiple simulations at once for comparative analysis

Video demonstration:

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