A Multi-Scale Animation Framework for Biological Fibrous Structures

Tobias Klein • Ivan Viola • Peter Mindek

In molecular biology, long polymers are common. To study their function and atomic structure, we often build computational models of them. An example is this model of a microtubule. Microtubules are long tubes found in eukaryotic cells. They are part of cytoskeleton - a structure that maintains the shape of the cell and fulfills various other functions.

Microtubules are dynamic. To study the process of their assembly and disassembly, biologists often use computer animation, as these processes cannot be observed with a microscope. However, creating such animations is difficult and expensive.

We are working on a framework which can be used to quickly create procedural animations of computational models of fibrous structures and polymers, such as microtubules. With our framework, it is possible to modify the original model, so that it includes dynamic behaviour, such as polymerization and depolymerization.

Another example of a polymer studied in molecular biology is DNA. Since we know the atomic structure of DNA, it is easy to create a static computational model of it. However, due to its complex multi-scale structure, it is difficult to manually animate the model.

The advantage of the procedural animations created with our framework is that they can be parametrized with the scientific data. In this way, it is possible to create accurate representations of dynamic processes, which can be updated whenever new data are gathered.

Besides modelling biological processes, our framework can be used to create illustrative animations. For instance, the illustrators can use it to create an animation of unwinding the double helix of the DNA for an easier explanation of its atomic structure. Our framework takes care of the smooth interpolation between the original and the unwound state of the DNA, so that instead of the technical realization, the illustrator can focus on the storytelling.

Our framework can be embedded into existing visualizations. Just as we embedded the DNA and the microtubules into this visualization of cytoplasm of an eukaryotic cell.

100 nm
1 000 000 x

Institute of Visual Computing & Human-Centered Technology • TU Wien

https://cg.tuwien.ac.at

powered by nanographics

https://nanographics.at