

# A novel Lecture Program in Bioinformatics: Interdisciplinary Cell Visualization and Modeling

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## 1 Introduction

The creation of a virtual cell scenario is a multidisciplinary vision. Cell modeling is a specific field which can be applied to a number of quite diverse approaches, starting from simulation-based ones, such as the Virtual Cell project - which is able to convert biological descriptions into a mathematical system of ordinary and/or partial differential equations - to visualization-based approaches, such as cellPACK - which is based on the idea to create visual filled cell representations [1], [2]. Integrative Bioinformatics is a field which tries to unite different information sources to solve biological questions. The CELLmicrocosmos project consists of a number of different projects trying to approach the vision of a virtual cell environment, such as [3], [4]. Starting from 2004, a remarkable number of students were involved in the aforementioned projects. In addition to our custom tools, also external tools, such as Blender, Fiji (IsJustImageJ), or GROMACS played an important role in our daily work [5-7].

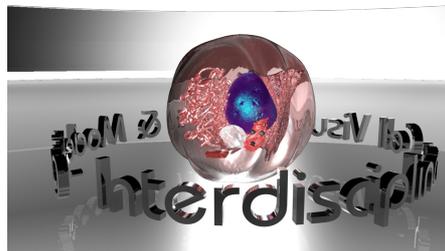


Figure 1: The logo of “Interdisciplinary Cell Visualization and Modeling”. The cell model goes back to the initial Bachelor thesis from 2004 created with Autodesk 3ds max®.

## 2 The Lecture Program

In 2012, the idea emerged to develop a teaching module. First, these course should provide the students with background knowledge concerning cytology, microscopy, modeling and simulation, as well as bioinformatics. And second, practical lessons should be included. Finally, a module was initiated and developed in 2012 consisting of three different parts:

1. the lecture “Interdisciplinary Cell Visualization and Modeling”, introducing the theoretical background,
2. different seminars, focusing and extending specific lecture topics (see below),
3. and the student project “CELLmicrocosmos Cell Modeling/Cell Visualization”, where the practical work - programing, 3D stereoscopic modeling and visualization, database applications - was carried out.

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Three different seminars were offered. “(Multidisciplinary) Cell Visualization” was focusing on cytological visualization, e.g. in school books or digital edutainment. The seminar “Stereoscopic 3D Visualization” discussed the technical background and the difficulties of demanding biological stereoscopic visualizations, which resulted in a short film presentation in a cinema and an accompanying publication [8]. Also, some work presented at the CELLmicrocosmos neXt workshop is a result of this new teaching module. Moreover, the seminar “Genome-wide biological Network Modeling and Analysis” discussed aspects like graph analysis, Petri net simulation, and the visualization of biological networks.

Based on this Sino-German collaboration between the Bio-/Medical Informatics Department Bielefeld and Bioinformatics Group of Zhejiang University, a bilateral exchange teaching and workshop program was started and there are a number of plans for our future collaborations. From 2012 to 2014, workshop events of this program took place in Bielefeld, Hangzhou, Harbin, and Tongliao. Moreover, a first book including some ideas of this collaboration was published in 2014 [9].

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