

A Storage, Processing, and Retrieval System for Microtubule Tracking Data

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Abstract

Given a set of cell microtubule images taken at regular time intervals, individual microtubule positions can be tracked over time. This position data can then be analyzed to obtain event information for an individual microtubule, as well as statistical data for a group of microtubules. An event can be one of three types: growth, shortening, or attenuation. Processing tracking data involves not only event classification but statistical calculation of which dynamicity is most prominent. A database was created to store the raw tracking information. Further, the task of calculating and storing event information, as well as related statistical automation, are automated. The database is web accessible through a visual interface capable of accepting queries and user initiated changes to the raw data. The system provides data processing support and capability that could be incorporated into a larger bioimage bioinformatics project: a searchable biological image database.

1. Introduction

Microtubules are cytoskeleton components of cells. Given a set of cell microtubule images taken at regular time intervals, individual microtubule positions can be tracked over time. The scope of this project was to automate tracking data extraction and processing.

2. Event Identification

Phase one of the project involved automated event identification. Position data was first extracted from source files. Coordinate information in the form of x and y plots were then converted into length displacements. This data was further processed to

obtain slope information that varies with time. By comparing any given slope with a predefined attenuation threshold an event could be determined depending on whether the slope exceeded, fell within the range of, or dropped below the attenuation threshold.

3. Database

Phase two of the project required the storage of raw and derived data into a relational database. The resultant schema included a Position table used to represent raw tracking data, an Event table used to represent event information, a Stack table used to represent identifying characteristics of a microtubule group, and a Parameters table containing all derived data and related statistical information.

4. Web Interface

Phase three called for the development of a web accessible user interface. The interface uses a sum of products query structure which allowed the user to enter a variable number of constraints contained within a variable number of constraint sets.

5. Results

A java based data extraction tool was created which included event identification and statistical analysis. A database schema was created to house all extracted data. A prototype query form was also created to illustrate one possible method of data searching. The goal of the project was to establish a proof-of-concept for the automation of microtubule event tracking.