

Computational Biology

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# Video Bioinformatics

From Live Imaging to Knowledge



EXTRAS ONLINE

 Springer

## Computational Biology 22

Andreas Dress · Michal Linial · Olga Troyanskaya · Martin Vingron *Series Editors*

Bir Bhanu · Prue Talbot *Editors*

### Video Bioinformatics

From Live Imaging to Knowledge

The advances of live cell video imaging and high-throughput technologies for functional and chemical genomics provide unprecedented opportunities to understand how biological processes work in subcellular and multicellular systems. The interdisciplinary research field of Video Bioinformatics is defined by Bir Bhanu as the automated processing, analysis, understanding, data mining, visualization, query-based retrieval/storage of biological spatiotemporal events/data and knowledge extracted from dynamic images and microscopic videos. Video bioinformatics attempts to provide a deeper understanding of continuous and dynamic life processes.

Genome sequences alone lack spatial and temporal information, and video imaging of specific molecules and their spatiotemporal interactions, using a range of imaging methods, are essential to understand how genomes create cells, how cells constitute organisms, and how errant cells cause disease. The book examines interdisciplinary research issues and challenges with examples that deal with organismal dynamics, intercellular and tissue dynamics, intracellular dynamics, protein movement, cell signaling and software and databases for video bioinformatics.

#### Topics and Features

- Covers a set of biological problems, their significance, live-imaging experiments, theory and computational methods, quantifiable experimental results and discussion of results.
- Provides automated methods for analyzing mild traumatic brain injury over time, identifying injury dynamics after neonatal hypoxia-ischemia and visualizing cortical tissue changes during seizure activity as examples of organismal dynamics
- Describes techniques for quantifying the dynamics of human embryonic stem cells with examples of cell detection/segmentation, spreading and other dynamic behaviors which are important for characterizing stem cell health
- Examines and quantifies dynamic processes in plant and fungal systems such as cell trafficking, growth of pollen tubes in model systems such as *Neurospora Crassa* and *Arabidopsis*
- Discusses the dynamics of intracellular molecules for DNA repair and the regulation of cofilin transport using video analysis
- Discusses software, system and database aspects of video bioinformatics by providing examples of 5D cell tracking by FARSIGHT open source toolkit, a survey on available databases and software, biological processes for non-verbal communications and identification and retrieval of moth images

This unique text will be of great interest to researchers and graduate students of Electrical Engineering, Computer Science, Bioengineering, Cell Biology, Toxicology, Genetics, Genomics, Bioinformatics, Computer Vision and Pattern Recognition, Medical Image Analysis, and Cell Molecular and Developmental Biology. The large number of example applications will also appeal to application scientists and engineers.

Dr. Bir Bhanu is Distinguished Professor of Electrical & Computer Engineering, Interim Chair of the Department of Bioengineering, Cooperative Professor of Computer Science & Engineering, and Mechanical Engineering and the Director of the Center for Research in Intelligent Systems, at the University of California, Riverside, California, USA.

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#### Computer Science

ISBN 978-3-319-23723-7



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