Biomedical Imaging

Image Analysis of Intra-cellular Structures

Telomere Quantification and Mitotic Spindle Analysis

Telomeres, which are the end pieces of linear chromosomes in eukaryotes, serve important roles in the protection, stabilization, and replication of the chromosome ends and are related to aging and cancer. Shortening of the telomeres can promote chromosome rearrangement that may contribute to cancerous transformation of the cell. The *mitotic spindle* is a temporary nuclear structure that separates duplicated chromosomes during cell division. Proper structure and function of the mitotic spindle is crucial for chromosome segregation and cell cycle progression. Computer vision researchers and functional genomics scientists at ORNL have teamed to develop novel algorithms and software to facilitate high-throughput life science experiments.

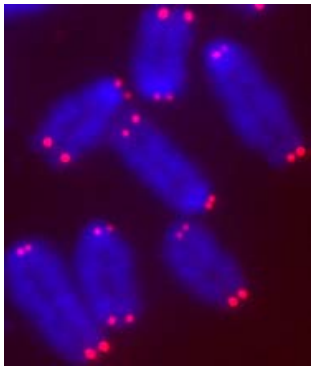

Figure 1. Chromosomes (blue) with telomeres indicated in red.

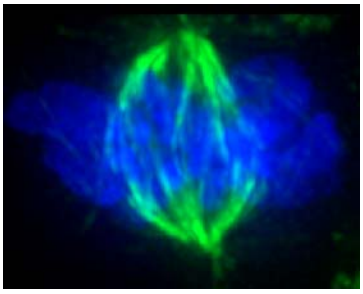

Figure 2. Chromosomes (blue) and the mitotic spindle (green) during cell division.

Technology

ORNL has developed image processing algorithms and user-friendly software for the automated analysis of telomere imagery (see Fig. 1). This software detects, segments, and quantifies (see Fig. 3) the amount of telomere material for each chromosome. The software can process a large batch of images automatically, allows manual interaction with the results, and allows cross-platform data export. The high-throughput nature of the software will permit life science researchers to perform more statistically robust experiments.

ORNL is also participating in ongoing research to develop automated image analysis software for characterizing the mitotic spindle (see Fig. 2) under a variety of conditions including gene knockout and drug exposure. Most anti-cancer drugs attack the mitotic spindle to prevent cell division. There are also many proteins that interact with the mitotic spindle in unknown ways. The products of this research will allow life science researchers the opportunity to explore the roles of these proteins and perhaps uncover new anti-cancer drugs.

Specifications and Features

- Windows interface, built with C++ and Visual Basic
- Batch processing and user-interactive modes
- Cross-platform (CSV) data export

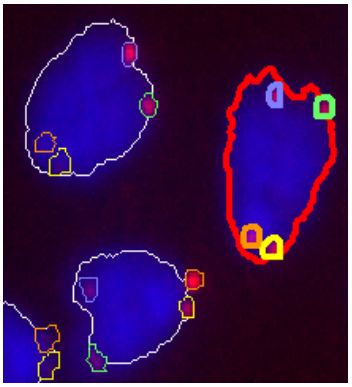

Figure 3. Segmented chromosomes and telomeres from the ORNL telomere analysis software.

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