Golgi body movement in the plant-cell secretory pathway

Unlike their mammalian counterparts, Golgi bodies in plant cells are highly motile. Dr John Runions and Professor Chris Hawes at the Oxford Brookes University, study this motion and the interaction of Golgi bodies with other components of the plant cell: the endoplasmic reticulum (ER), cytoskeleton, peroxisomes etc. The aim is to understand what cellular function this movement has. Currently involved in the European Pharma Planta initiative, the Hawes group believe that there may be a therapeutic outcome in studying the production of medicinal proteins in plant cells where the Golgi pathway could play a key role. Organelles can be marked with fluorescent proteins in living cells of Arabidopsis and tobacco and the movement and interactions studied using timelapse imaging.

The images shown here are from an experiment in which the ER has been labelled with a calnexin-photoactivatable GFP construct which causes the ER to adopt a more sheet-like morphology than normal. Images were captured in Z and over time using a confocal microscope. The data was then imported into Volocity for analysis.

Figure 1 shows a high resolution rendering of a 3D image stack produced using Volocity Visualization after the confocal images were processed using Volocity Restoration to further improve the resolution. The Golgi bodies are visible as red dots within the lacunae of the ER.

Volocity Classification was used (Figure 2) to map the movement of Golgi bodies in 4D. Five Z-sections were acquired with a Z-step of 1 µm over 30 timepoints. New thresholding algorithms, such as Percentage Intensity thresholding, allow very precise automatic tracking. Golgi tracks were visualized and a wealth of statistical data on Golgi movement was generated into a table that can be exported into any standard industry spreadsheet. These researchers have been able to compute characteristics of Golgi movement such as, velocity, track length, displacement. Measurement of meandering index indicates if the Golgi bodies move in a straight line or meander about. Finally, the tracking data can be used to produce a chart in Volocity Classification showing relative vectorial tracks for further analyses (Figure 3), which can be exported as an image for inclusion in a paper or presentation.