3D Skeletonization

Generate a 3D Skeleton from a 3D Image

The Aphelion™ 3D Skeletonization module is an optional module[1] to compute a one-voxel thickness, connected skeleton from a binary 3D image. The process used is based on advanced work carried out at the Ecole des Mines de Paris (France) and Monash University (Australia).

The Aphelion 3D Skeletonization module is a robust and highly accurate process that is especially well-suited to the analysis of intricate objects like branched structures (see Figure 1). The module's output is a set of one-voxel thickness branches represented in a tree-like structure (see Figure 2). The resulting skeletonization is actually an Aphelion ObjectSet containing new attributes related to the skeleton, including a set of features associated with each branch, such as:

Fig. 1 – Branched structure example

- Branch index
- Level of branch in the hierarchy
- Branch length (raw and calibrated)
- Length from each branch to the root
- Associated skeleton label
- Mother branch index
- Number and index of each child branch
- Node coordinates in the 3D space

Although the software initially sets the root of the skeleton, the user can manually set a different root. The tree structure and associated attributes are then automatically recomputed. With this method, the user can exhaustively analyze each connected component.

Figure 2 – Skeletonization result

Typical applications include analysis of blood vessels, neural systems, and any tree-like structure in 3D space. 3D skeletons greatly enhance a user's ability to quickly extract quantitative data from complex 3D structures.
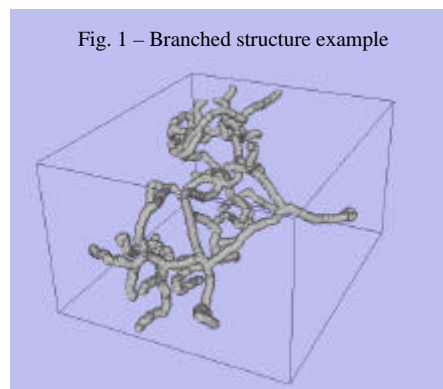

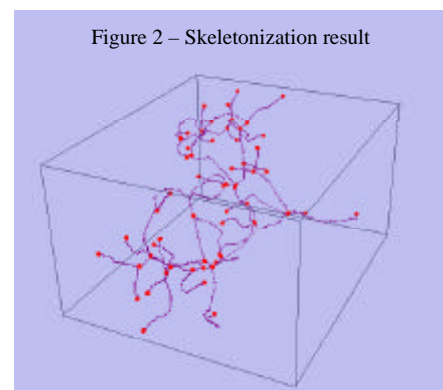### Main Benefits of the Aphelion™ 3D Skeletonization Module:
- Rapid computation of a one-voxel thickness skeleton
- Tree-like representation of the skeleton
- User can specify a new root, causing recomputation of the skeleton
- Computation of a comprehensive set of skeleton features
- Skeleton features accessible in spreadsheet format

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(1) Use of the 3D Skeletonization module also requires Aphelion™ Developer and the Aphelion™ 3D Image Processing module to be installed and executable. The Aphelion™ 3D Image Display module is highly recommended.

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