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3D Image processing and image display of the vascular network in OCT-Angiography images

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Purpose: The release of new systems to capture OCT-angiography images has opened a broad new field of image quantification directly performed on 3D volume of data. Our goal is to develop custom and fully automatic software to display and analyze segmented 3D OCT-angiography images, to highlight the presence of microaneurysms, ischemic areas, and to provide accurate measurements.

Methods: 3D OCT-angiography and OCT En face images were captured by the Spectralis system (Heidelberg Engineering, Germany). A set of 30 volumes from 15 patients was used to develop and validate the software. The volumes were exported in raw format and opened in the software. The segmented volume is then automatically displayed in the user interface 3D viewer, along with the infra-red image and the OCT-A images. Window synchronization is available between image windows to let the user visually see the location of each image versus the other images. The user can rotate the volume in all directions, zoom in and out, alter the color of the volume and generate a movie that shows the volume in all positions. The displayed vessel network is the result of a true 3D segmentation algorithm performed on the OCT-angiography volume. The algorithm and the result display rely on three of the 3D extensions of the Aphelion imaging software suite (image processing, image display, 3D skeletonization). The algorithm is based on morphological image processing functions. It is capable of extracting the vessel network, computing the skeleton of the vessel network, and displaying each branch of a vessel in a different user-selectable color. The software also allows to manually count microaneurysms, and to automatically compute ischemic area surface and volume vessel density.

Results: The software lets the user analyze the whole set of 30 volumes, and generate measurements on pathologies. Videos of the vessel network in the 3D space were generated and demoed.

Conclusion: The automatic quantification of OCT-angiography images performed with the software was found to be very reproducible. This innovative software allows displaying OCT-angiography images and quantifying pathologies within the same environment and user interface. The software will be adapted to other image formats captured by other systems. Future versions are currently under development to follow hardware evolution, software development regulations, as well as answering first user suggestions and comments.

Notes: