Construction of patient specific 3D hemodynamic models through 2D angiograms for diagnosis and prognosis of atherosclerosis

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Value Proposition

Atherosclerotic Cardiovascular Disease is the leading cause of death globally. By some accounts, it claims as many as 17.3 million lives every year. Current diagnostic tests such as CT Angiography and Coronary angiography rely on experienced angiographer to mentally reconstruct the 3D structure from 2D angiograms of blood vessels, leading to subjective and non-standardized interpretation and erroneous diagnostics. Several technologies have been developed for reconstructing 3D hemodynamic models and computational fluid simulations on a per patient basis, from CT angiography. CT angiography is however used only in a fraction of cases. Coronary angiograms are more widely available, however, especially in retrospective cases. No methods exist so far for deriving 3D fluid flow information from 2D coronary angiography data.

Technology

Researchers at Duke university have developed systems and methods for constructing personalized and accurate 3D simulations of hemodynamics from existing 2D angiogram data. These models and simulations can determine key hemodynamic risk factors such as pressure gradients and wall shear stress in the coronary artery of the subject and can be used in the diagnosis of vascular diseases. Such 3D models will also serve as a cost-effective tool in understanding the progression of atherosclerosis and in treatment planning.

Advantages

- Coronary angiography data has higher resolution and is more accurate than CT angiography
- The methods work on existing angiography data, and do not require new tests to be performed
- Retrospective models can be constructed
- Models are personalized and can be used to predict the progression of disease
- They thus allow patients and physicians to plan treatments in advance

Publications

- Massively parallel simulations of hemodynamics in the primary large arteries of the human vasculature. J. Comp. Sci., 9:70–75. (2015)

Patents

Patent Number: 10,748,451

Title: SYSTEMS AND METHODS FOR USING FLUID SIMULATION IN VASCULAR GEOMETRIES

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