6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11 – 15 June 2018, Glasgow, UK

ANEURYSM DETECTION AND MONITORING BY MEASURING AND ANALYSIS OF ARTERIAL PRESSURE/VELOCITY WAVEFORM

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Key Words: *aneurysm detection, blood pressure waveforms, one-dimensional modelling.*

An aortic aneurysm is a progressively growing dilation of the aorta with a risk of potentially lethal rupture. Successful treatment of an aneurysm depends on how early it has been detected. To detect an aneurysm on time, a continuous and expensive screening programme is necessary. Ultrasound (US) echography is mainly used in AAA (abdominal aortic aneurysm) screening programmes but it has limitations due to the fact that aorta is buried deep in the body. It is also inapplicable for the thoracic aortic aneurysm (TAA) detection. Other methods like 3D CT, MRI are expensive and are mainly applied at the latter stages of the aneurysm evolution.

We propose here a novel non-invasive method of AAA/TAA detecting and monitoring which comprises measuring of the blood pressure/velocity waveforms in accessible parts of a human body followed by analysis the waveforms by means of special algorithms. Development of the aneurysm detecting algorithms is based on 1D modelling of systemic circulation and approximation of an aneurysm by a lumped (0D) model. A new numerical scheme is proposed which combines the perturbation method and the fast Fourier transform (FFT). Its effectiveness is shown for the 1D numerical modelling of cardiovascular systems with aneurysms.

The proposed method allows determination of aneurysm location on aorta and its severity parameter which incorporates the aneurysm size and mechanical properties of its wall. The method is justified experimentally in the simplified arterial network and in the numerical modelling of the human arterial network. The method can provide clinicians with a non-expensive, easily accessible tool for aneurysm screening, monitoring and the intervention time estimation.

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