Non-invasive Measurement of Pressure Gradients in Pulsatile Flow using Ultrasound - DTU Orbit (11/12/2018)

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This paper demonstrates how pressure gradients in a pulsatile flow environment can be measured non-invasively using ultrasound. The proposed method relies on vector velocity fields acquired from ultrasound data. 2-D flow data are acquired at 18-23 frames/sec using the Transverse Oscillation approach. Pressure gradients are calculated from the measured velocity fields using the Navier-Stokes equation. Velocity fields are measured during constant and pulsating flow on a carotid bifurcation phantom and on a common carotid artery in-vivo. Scanning is performed with a 5 MHz BK8670 linear transducer using a BK Medical 2202 UltraView Pro Focus scanner. The calculated pressure gradients are validated through a finite element simulation of the constant flow model. The geometry of the flow simulation model is reproduced using MRI data, thereby providing identical flow domains in measurement and simulation. The proposed method managed to estimate pressure gradients that varied from 0 kPa/m–7 kPa/m during constant flow and from 0 kPa/m–200 kPa/m in the pulsatile flow environments. The estimator showed, in comparison to the simulation model, a bias of -9% and -8% given in reference to the peak gradient for the axial and lateral gradient component, respectively.

General information
State: Published
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Pages: 2022
Publication date: 2013

Host publication information
Title of host publication: Proceedings of IEEE International Ultrasonics Symposium
Publisher: IEEE
Electronic versions:
paper_final.pdf
DOI:
10.1109/ULTSYM.2013.0516
Source: dtu
Source-ID: u::8117
Research output: Research - peer-review › Article in proceedings – Annual report year: 2013