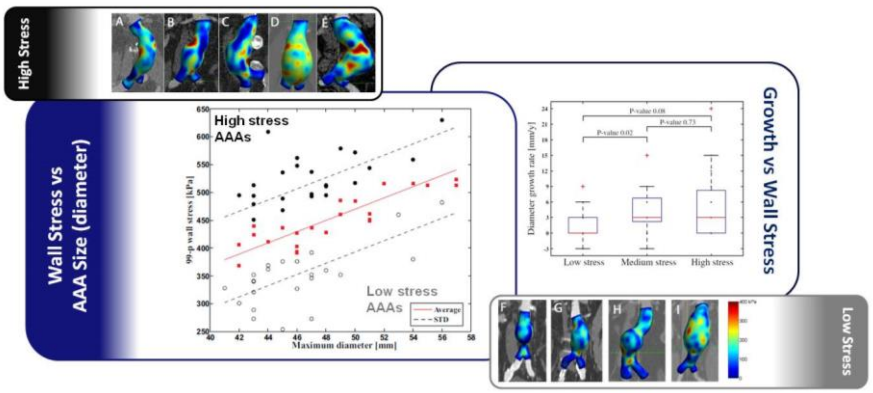
KTH SOLID MECHANICS SEMINAR; Monday, December 19th, 15.15; KTH Solid Mechanics Seminar room

Frans N. van de Vosse "Cardiovascular biomechanics: from mathematical models to clinical applications"

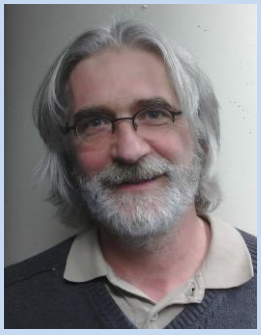
Patient specific computational modelling of the cardiovascular system will play an increasing role in diagnostics of cardiovascular disease and planning of surgical intervention and medical treatment.

Five main steps towards the clinical applicability of these computational models can be discerned. First, the mathematical model and the applied computational technique must be developed based on physical understanding of the final clinical application. In general the mechanical interaction between blood flow and cardiovascular tissue deformation must be dealt with in a fluid-structure interaction model. Next these models need to be verified with respect to the physical phenomena they are supposed to describe. In many cases in-vitro models that represent a specific site of the cardiovascular system can be used for this purpose. Thirdly, proper constitutive models for both the solid as well as the fluid must be defined and parameters must be derived from either ex-vivo or in-vivo experimental studies. Next, clinical measurement and imaging techniques that are suitable to assess the parameters that define the patient specificity of the model must be developed and evaluated. Finally, the predictive value of the computational model must be determined using clinical studies.

In the presentation this sequence of steps will be illustrated taking currently conducted real life clinical studies with respect to coronary artery disease treatment, abdominal aortic aneurysm growth, and vascular access surgery for dialysis patients as a point of departure.



Mathematical modelling shows the relation between patient's geometry-specific wall stress and maximum diameter of abdominal aortic aneurysms. High "diameter-weighed stress" is related to rapid growth (Speelman et al. 2010).



Prof.dr.ir. F.N. van de Vosse, is professor of Cardiovascular Biomechanics at Eindhoven University of Technology (TU/e). From 1976 to 1982 he graduated from the department of Applied Physics at TU/e. He received his PhD degree from the same university in 1987 (Koninklijke Shell PhD award, 1987) on "numerical analysis of carotid artery flow". From 1987 to 2001 he was lecturer in fluid mechanics with the Polymer Technology group of Prof. Han Meijer in the department of Mechanical Engineering. In 2001 he was appointed at the department of Biomedical Engineering to lead the group of Cardiovascular Biomechanics. After a visiting professorship at Stanford University in 2001 he was co-founder of the master's program Medical Engineering of TU/e and appointed as honorary professor of Cardiovascular Biomechanics at University Hospital in Maastricht (MUMC). In 2005, in collaboration with the department of Applied Physics at TU/e, he co-founded the post-graduate School of Medical Physics and Engineering. His current research expertise is related to the computational and experimental biomechanical analysis of the cardiovascular system and its application to clinical diagnosis and intervention, cardiovascular prostheses, extra corporeal systems and medical instruments and devices.