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Quantification of in vivo fluid dynamics in diseased left ventricles and aortas

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Space and time-resolved phase contrast magnetic resonance imaging (4D-flow) is the latest advancement in phase-contrast magnetic resonance imaging. 4D-flow data yield the quantification of the space- and time-dependent velocity field of blood within heart chambers and vessels, as well as within blood-processing devices.
By developing processing tools that allow for coping with data noise and artefacts, it is possible to compute derived quantities, such as shear stresses [1] and relative pressures [2], which can be translated into clinically relevant indices.
The latest activities carried out at Politecnico di Milano in this specific field of research and within the framework of the Ammodit project will be showcased. Moreover, ongoing developments will be presented, with an emphasis on the analysis of the in vivo fluid-dynamics i) in the left ventricle affected by post-ischemic disease and ii) in the thoracic aorta affected by coarctation. In these two specific clinical scenarios, the exploitation of 4Dflow data may be particularly challenging and require novel processing techniques. The possibility for applying adsvanced mathematical methods to cope with these issues will be discussed.

[1] F. Piatti et al. BAV-related fluid-dynamic alterations and aortopathies: evidence of wall shear stress alterations in absence of clinically-relevant aortic remodeling. Frontiers in Physiology. 2017. 8:article 441. DOI:10.3389/fphys.2017.00441
[2] F. Piatti F, et al. Experimental quantification of the fluid dynamics in blood-processing devices through 4D-flow imaging: a pilot study on a real oxygenator/heat-exchanger module. Journal of Biomechanics, Feb 2018;68:14-23. doi: 10.1016/j.jbiomech.2017.12.014