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Combined measurements of flow-induced shear stress and gene expression of individual endothelial cells MASSIMILIANO ROSSI, RALPH LINDKEN, Delft University of Technology, BEEREND P. HIERCK, Leiden University Medical Center, JERRY WESTERWEEL, Delft University of Technology — It is known that endothelial cells respond to the biomechanical forces induced by the blood flow by remodeling their shape. It is also postulated that different shear stress patterns modulate the gene expression of the cells. The mechanism by which they sense shear stress and the mechanotransduction pathway governing the blood-vessel wall interaction is still unknown and object of investigation. We used an optical, non-tactile measurement technique based on μPIV to investigate the relationship between shear stress distribution, shape and gene expression on a single-cell level. The cells are cultured in parallel flow chambers and subjected to different flow conditions. The fluid flow velocity in several planes over the cell is measured. From the three-dimensional flow field velocity profiles are extracted and used to reconstruct the cell topography and the shear stress distribution over it. This technique allows to achieve a spatial resolution of up to 1 μm attaining an average of 500 data points for each single cell. The gene expression measurements are performed with a shear responsive pKLF2-EGFP promoter construct transfected in the cells. Results will be shown on endothelial cells subjected to a steady flow inducing a nominal wall shear stress level of 1.5 Pa.

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