15th International Symposium on Computer Methods in Biomechanics and Biomedical Engineering
and
3rd Conference on Imaging and Visualization
**CMBBE 2018**
*P. R. Fernandes and J. M. Tavares (Editors)*

Abstract ID-93

# PARTICLE SYSTEMS FOR PATIENT-SPECIFIC MODELING OF THE MITRAL VALVE

*Patricia Lopes[(1)], Roel Wirix-Speetjens[(1)], Johan Bosmans[(2)], Jos Vander Sloten[(3)]*

[(1)]**Materialise NV, Belgium**
*Patricia.Lopes@materialise.be*

[(2)]**University Hospital Antwerp, Belgium**

[(3)]**Katholieke Universiteit Leuven, Belgium**

**Keywords:** mitral valve, particle systems, transesophageal echocardiography (3DTEE)

**Summary:** With the rise in percutaneous mitral valve repair and replacement procedures, the focus on computational models to simulate and predict the outcome of such interventions has increased in the past few years. Various methods have been reported for the generation of finite element (FE) meshes from medical images. Nonetheless, two main limitations are noticeable: 1) the level of automation for extracting the mitral valve geometry, and 2) the inclusion of local thickness information for the leaflets. While a few authors have described highly automated methods to obtain these meshes [1, 2], most publications alluded to the need for considerable user-interaction. Additionally, leaflet thickness information, an essential boundary condition for the accurate simulation of healthy and pathological mitral valve biomechanics, is commonly simplified. The leaflet thickness is either considered uniform, or is linearly interpolated along the leaflet surface based on literature values.

In this work, we evaluate particle system methods for automatically generating surface representations of the mitral valve leaflets, including local information on leaflet thickness. Five three-dimensional transesophageal echocardiographic (3D TEE) studies were acquired for patients with different types of mitral valve disease. After selecting the end-diastolic phase, we increased the contrast between leaflets and background, and defined a region of interest around the mitral valve. A particle system implementation was subsequently applied to the original images and limited to the region of interest. The resulting point clouds were meshed using a surface reconstruction filter, and subsequently overlaid onto the 3D TEE images to verify the location of the mitral leaflets. The results indicate that detailed representations of the mitral valve containing local information on the leaflet thickness can be automatically obtained from particle systems, in order to be used as input for computer simulations.

**References**

[1] Pouch, A. et al., "Semi-Automated Mitral Valve Morphometry and Computational Stress Analysis Using 3D Ultrasound", Journal of Biomechanics, Vol. 45, No. 5, pp. 903-907, 2012.

[2] Drach, A. et al, "A comprehensive pipeline for multi-resolution modeling of the mitral valve: Validation, computational efficiency, and predictive capability", International Journal for Numerical Methods in Biomedical Engineering, 2017.