Automatic assessment of blood flow in the pulmonary veins using 4D Flow MRI

Contact: federica.viola@liu.se, mariana.bustamante@liu.se

Background: Atrial function is important in the diagnosis of many cardiac diseases. Unfortunately, it is difficult to assess using the current clinical tools. Time-resolved three-dimensional phase-contrast magnetic resonance imaging (4D Flow MRI) is increasingly used in research and clinical settings. As it allows for retrospective placement of analysis planes in the acquired volume, 4D Flow MRI lends itself well for flow visualization and flow volume quantification, including locations in the cardiovascular system not easily reached with other modalities. Blood flow in the pulmonary veins is of extreme interest, as it can allow the study of atrial function. However, thus far, pulmonary veins blood flow assessment from 4D flow MRI has been performed manually, which is extremely time-consuming. We have recently developed an approach, using atlas-based registration for segmentation of vascular 4D flow MRI (Bustamante 2015), which has recently been expanded (Bustamante, 2017), allowing for automatic segmentations of the ventricles and main blood vessels (Figure 1). By using these atlas-based segmentations and potentially additional methods, e.g. particle tracing, it would be possible to define rules for setting analysis planes in the pulmonary veins automatically, to extract blood flow curves. Pulmonary veins blood flow extracted from 4D flow MRI has great potential for the assessment of atrial function, on its own, or as input to the cardiovascular functional avatar (Casas 2017).

Aim: We aim to develop a method to automatically extract all pulmonary veins blood flow curves from 4D Flow MRI data, by exploiting atlas-generated segmentations. The flow curves thus generated can serve as input to a functional model of the heart, e.g. the cardiovascular functional avatar.

References

Figure 1: Atlas-based segmentation and vessel flow assessment.