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Velocity Measurements in Cardiac Magnetic Resonance Imaging

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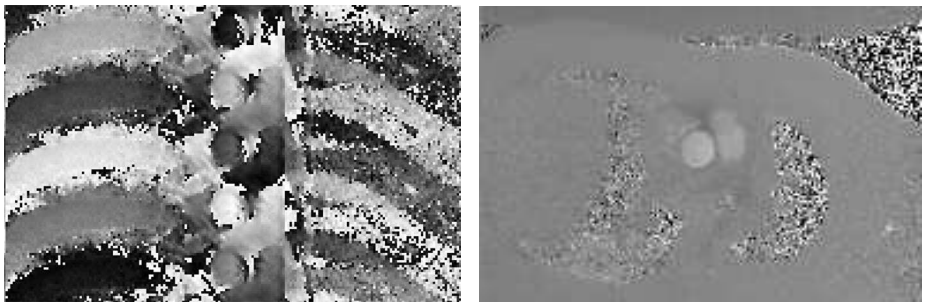
About the Cover

As was pointed out in the aim of this thesis (Section 1.4), the current technique for velocity measurements at the mitral valve is limited by the long acquisition times in combination with insufficient contrast and signal intensity. Part I investigated different techniques to improve the contrast between blood and myocardium. Though, this research was not performed after initial research set out to reduce the acquisition times. Unfortunatelly, this project came to a standstill due to the insufficient signal intensities. The image on the cover is a result from this initial research.

The possibility of reduction of the acquisition times can be understood conceptually from the fact that the image frames through the cardiac cycle show significant correlation in space and time. In principle, it is possible to acquire only a subset of the data and reconstruct the missing information afterwards. However, as MRI acquires its data in the spatial frequency spectrum (k-space) where every data point contains information about every pixel in the final image (Section 1.1), the reconstruction is not a straight forward problem.

The cover image is taken from the reconstruction proces of a phase map of a through-plane velocity measurement in the aorta, similar as the image shown in Figure 1.5. The curved shape of the chest wall can still be recognised. The subset of data that was acquired, is a five-fold undersampling in k-space which results in aliasing in the final image. Hence the (vertically) repeating pattern that can be observed in the cover image. The reconstruction process handles the time-averaged component of the data separately from the time-varying component. The cover image shows the time-varying component from breathing motion in the chest wall and blood flow through the arteries. By pure coincidence the pulsating blood flow resulted in a heart-shaped symbol. The figure below shows the original image that was used for the cover and the accompanying reconstructed image.



On the left the time-varying component of the five-fold undersampled phase map that was used for the cover. On the right the resulting phase map from the reconstruction process showing a through-plane velocity measurement in a plane just after the aortic valves.