Appendix B: deformable registration

The *Advanced RegLibNonParametric Module* in MeVisLab was used for this matrix-free deformable registration. [19] The deformation process aims to minimize the cost function, with the normalized gradient field distance measure [20], which emphasizes the alignment of image gradient between the fixed image and the deformed moving image. To address the optimization problem, the method employs the limited-memory Broyden-Fletcher-Goldfarb-Shannon (L-BFGS) optimization scheme. This optimization process is integrated into a multi-level scheme for enhanced performance.

Parameter optimization

The influence of the edge parameter and the weight regularization parameter on the patient data was tested on one patient. First, the subtracted volumes were judged visually. After this, the sum of the absolute differences between time phase 50% and time phase 0% was calculated for one patient. This was done for the regularization weight and after this for the edge parameter. This can be seen in figure B1.

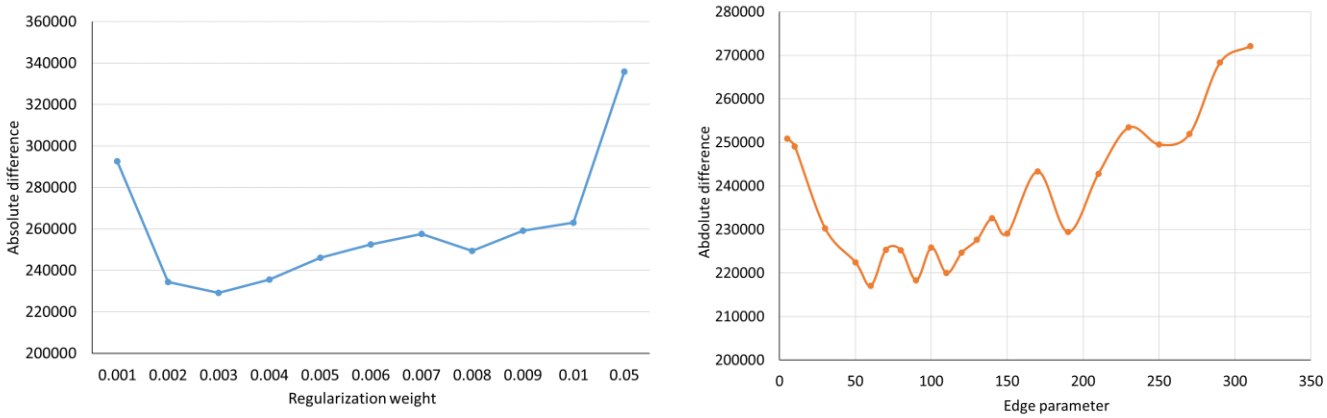

Figure B1 Optimization of the deformable registration. First on the regularization weight (a) and after this on the edge parameter (b)

Based on these results, the regularization weight was set on 0.003 and the edge parameter on 80 for all patients. On each subvolume, the deformable registration was performed for each time phase to the first time phase of the corresponding cardiac cycle. For each subvolume, an averaged volume was determined, using 10 time phases (0%, 10%, … , 90%) of each cardiac cycle. A seed point was selected within the vessel, whereafter a mask was created for each vessel (averaged mask), using region growing. A dilation of this mask (4x4x4 kernel) was used during the deformable registration to focus the registration on this vessel, and not on surrounding structures.