Section: **Segmentierung, Registrierung**

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Abstract-Title:
4D-INTERPOLATION-SCHEME OF THE LEFT VENTRICULAR WALL MOTION4D-INTERPOLATION-VERFAHREN FÜR DIE LINKSVENTRIKULÄRE WANDBEWEGUNG.

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Abstract-Text:
Purpose:
The manual segmentation and analysis of 4D-high-resolution multi-slice cardiac CT datasets is both labor intensive and time consuming. Therefore, it is necessary to supply the cardiologist with powerful software tools to segment the myocardium and the cardiac cavities.

In recent years there have been several publications concerning the segmentation and analysis of the left ventricle and myocardium for a single phase or for the diagnostically most relevant phases, the end-diastole (ED) and the end-systole (ES). However, for a complete diagnosis and especially of wall motion abnormalities, it is necessary to analyze not only the motion endpoints ED and ES but also all phases in-between. Certainly a single phase approach applied to all phases could be used but this would be highly ine-cient and would potentially lead to inconsistent segmentation results.

In this paper, a novel approach for the interpolation between ED and ES is presented. As the cardiac wall motion is highly individual it is crucial to integrate anatomical knowledge in the interpolation process. Therefore, we compute the individual volume curve for the interpolation between ED and ES segmentation results. This results in a fairly accurate initialization of the phases between ED and ES which could be used for a subsequent fast and robust 4D segmentation step.

Method:
As the contrast between bloodpool and surrounding myocardium is quite high, a simple segmentation approach like a regiongrowing is appropriate to compute the ventricle volume. For a complete volumecurve such an bloodpool segmentation could be individually applied to all cardiac phases. However, this could lead to inconsistent results. Therefore we only apply the bloodpool segmentation[1] to a single phase and use the result to consistently segment all other phases. This is done via a bloodpool segmentation of the ED phase and by a threshold-segmentation of all other phases constrained by the resulting mask of the ED bloodpool segmentation. As the ED phase is not known in advance, we use the 80% phase for the bloodpool segmentation and apply a morphological dilatation afterwards to be sure that the resulting mask is larger than every other bloodpool. As a side effect of this method the true ED and ES is known after analyzing the computed volumes.

After obtaining the volumes for each cardiac phase, a continuous volume curve is computed via a B-spline passing through the discrete volume values of all phases. This volume curve can now be used to interpolate between the results of the myocardium segmentation[2] for ED and ES.

Results:
If the initial myocardium segmentation for ED and ES is assumed correct, the interpolation results for the phases between ED and ES are very accurate. First tests showed that the mean point to mesh error is below 0.5mm for most phases and most datasets, hence subpixel accuracy has been achieved.

Conclusion:
We presented a novel approach for the interpolation between segmentation results for ED and ES which is based on the computed individual volume curve. It could be shown that this approach produces interpolation results very close to the real contours which makes it an ideal preprocessing step for a subsequent 4D-segmentation of the myocardium since it allows the contraint of the segmentation to very small serach-intervals which would make the 4D-segmentation of the myocardium faster and more robust.

[1] D. Fritz, D. Rinck, R. Unterhinninghofen, R. Dillmann, M. Scheuering, "Automatic Segmentation of the Left Ventricle and Computation of Diagnostic Parameters Using Regiongrowing and a Statistical Model", in Proc. SPIE Medical Imaging, San Diego (USA), 2005
[2] D. Fritz, D. Rinck, R. Dillmann, M. Scheuering, "Segmentation of the left and right cardiac ventricle using a combined bi-temporal statistical model", in Proc. SPIE Medical Imaging, San Diego (USA), 2006