Segmentation of anatomical structures in chest radiographs using supervised methods: a comparative study on a public database - DTU Orbit (06/01/2019)

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The task of segmenting the lung fields, the heart, and the clavicles in standard posterior-anterior chest radiographs is considered. Three supervised segmentation methods are compared: active shape models, active appearance models, both first proposed by Cootes et al. and a multi-resolution pixel classification method that employs a multi-scale filter bank of Gaussian derivatives and a k-nearest-neighbors classifier. The methods have been tested on a publicly available database of 247 chest radiographs, in which all objects have been manually segmented by two human observers. A parameter optimization for active shape models is presented and it is shown that this optimization improves performance significantly. It is demonstrated that the standard active appearance model scheme performs poorly, but large improvements can be obtained by including areas outside the objects into the model. For lung field segmentation, all methods perform well, with pixel classification giving the best results: a paired t-test showed no significant performance difference between pixel classification and an independent human observer. For heart segmentation, all methods perform comparably, but significantly worse than a human observer. Clavicle segmentation is a hard problem for all methods; best results are obtained with active shape models, but human performance is substantially better. As an application, the cardio-thoracic ratio is computed automatically from the segmentation results. Bland and Altman plots indicate that all methods perform well when compared to the gold standard, with confidence intervals from pixel classification and active appearance modeling very close to those of a human observer. All results, including the manual segmentations, have been made publicly available to facilitate future comparative studies.

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