**Local progression estimation of pulmonary emphysema using image matching**

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**Introduction:** Whole lung densitometry on chest CT images is a clinically accepted method for measuring tissue destruction in pulmonary emphysema. Assessment of effect of new drugs for emphysema warrant local quantification of changes in severity of emphysema.

**Objectives:** To develop methods to locally evaluate emphysema progression.

**Methods:** Methods are based on matching follow-up chest CT scans using an intensity-based image registration technique, followed by subtracting baseline from follow-up images to estimate progression, while taking lung volume change into account. The first method assumes that lung mass is preserved and the second method is based on the observation that the volume-density slope is not necessarily fixed. The latter requires a third CT scan at a different inspiration level to estimate this slope locally. In a pilot study, both methods were applied to a lung phantom, where mass is known to be constant. Additionally, emphysema progression of three patients was graded visually by an MD, separately for apex, middle region and lung base, and these results were compared to the automatic methods.

**Results:** Both methods were able to reproduce the expected absence of progression in the phantom, the second method having the lowest error (mean error: $3.1 \pm 5.8$ HU and $-0.2 \pm 4.0$ HU). Both methods showed good correspondence with the visual assessment, the second method being slightly better.

**Conclusions:** Image matching and the subsequent analysis of differences according to the proposed lung models is a potential tool for localizing emphysema progression in drug evaluation trials.