We proposed a learning based method to estimate personalized patient surface models. Existent approaches include template deformation using scaling factors from anatomical measurement [3] and scaling factors from body mass index [4]. We generate personalized computational phantoms including internal organs using a learning based approach.

**Materials and Methods**

**Training data**
- Patient surface models: avatar database (standing)
- Segmented 3D diagnostic scans: Visceral Anatomy3 (supine) [5]

**Internal body cavities**
- Minimal convex hull around selected organs
- Modeled individually, e.g. for thorax and abdomen

**Patient-dependent boundary determination** (Fig. 1a)
- Learn a joint subspace linking patient metadata with patient surface model in standing pose based on the avatar database
- Estimate for each CT scan a surface model using associated metadata and align the estimate with segmented surface
- Calculate gravity deformation field to adjust the estimates from standing to supine pose
- Learn a joint subspace linking patient metadata with surface models in standing pose, gravity deformation fields, and cavities model.

**Internal organ model fitting** (Fig. 1b)
- Estimate internal cavity based on associated patient metadata
- Select N closest datasets from database matching metadata
- Non-rigid registration between estimated and selected cavities
- Propagate the segmentation of selected ground truth to the estimates
- Merge and extract segmentation using popular vote

**Results and Discussion**

**Evaluation data**
- Validation dataset: Visible Human [6] and Golem [7].
- Test dataset: 9 full-body CTs
- Organ volume estimation error: $30.6 \pm 15.0\%$ (Fig. 2a)
- Mean center of gravity error over all organs: $23.5 \pm 8.3$ mm (Fig. 2b)
- High inter-patient variation for organ mass and dimensions
- Planned: convert computational model to attenuation maps and evaluate for attenuation correction

**Conclusions**

- We proposed a learning based method to estimate personalized computational phantoms (including organs) using patient metadata only.
- Good accuracy for organ localization

**References**

[1] Singh et al., MICCAI (2014)

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