Move Over There: One-click Deformation Correction for Image Fusion during Endovascular Aortic Repair

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Endovascular aortic repair (EVAR) is an X-ray guided procedure for treating aortic aneurysms with the goal to prevent rupture. During this minimally invasive intervention, stent grafts are inserted into the vasculature to support the diseased vessel wall. By overlaying information from preoperative 3-D imaging onto the intraoperative images, radiation exposure, contrast agent volume, and procedure time can be reduced. However, the reliability of this fusion can deteriorate during the course of the procedure because the interventional instruments deform the vasculature. In [1], we propose an approach that models the deformation caused by stiff wires by integrating minimal user action into the otherwise fully automatic deformation correction method. Based on a single click on a relevant vascular landmark in a 2-D fluoroscopic image, we derive a projective constraint that is used in an as-rigid-as-possible deformation modeling approach. This allows to deform the preoperative information of the aortic and iliac vessels in 3-D to match the intraoperative situation with clinically relevant accuracy. The proposed approach recovers the position of the right and the left iliac bifurcation up to a mean 3-D error of 1.9 mm, with an error of 0.5 mm orthogonal to the viewing direction, and an error of 1.7 mm in depth, compared to 11.6, 7.8 and 7.9 mm before deformation correction. With a mean computation time of 6 s, the approach can be integrated smoothly into existing clinical workflows for EVAR.

Disclaimer. The methods and information presented here are based on research and are not commercially available.

References

1. Breininger K, Pfister M, Kowarschik M, et al. Move over there: one-click deformation correction for image fusion during endovascular aortic repair. In: Medical Image Computing and Computer Assisted Intervention – MICCAI 2020; 2020. p. 713–723.