Winter School Project

Aortic 3D Deformation Reconstruction

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Problem description: Although a 3D vessel structure is available pre-operatively by computed tomography (CT) scans, the vessel is soft and deforms during the procedure. This means the pre-operative data cannot be used directly to perfectly reflect aortic current shape, and therefore, the deformation should be updated intra-operatively.

Purpose: The purpose of this project is to inform you a recent framework that recovers aortic 3D deformation using a pre-operative model and two intra-operative X-ray images from two different viewing directions.

Main reference: Paper: Y. Zhang, L. Zhao, and S. Huang, Aortic 3d deformation reconstruction using 2d x-ray fluoroscopy and 3d pre-operative data for endovascular interventions, in 2020 IEEE International Conference on Robotics and Automation (ICRA). IEEE, 2020, pp. 2393-2399.

Code: We provide a Matlab implementation of conventional embedded deformation graph.
https://github.com/YanhaoZhang/Embedded-Deformation-Graph-for-Winter-School

Data: The necessary data can be downloaded from: https://github.com/YanhaoZhang/Embedded-Deformation-Graph-for-Winter-School

Project step: The participants will be asked to complete the following exploration steps based on the provided code. Some more detailed documentation can be found from https://github.com/YanhaoZhang/Embedded-Deformation-Graph-for-Winter-School

- **Model Projection** First project model point clouds to each image frame using the given camera pose. Then calculate the edge from the 2D projected point cloud.

- **Pixel-vertex Correspondence** Calculate the correspondence between the contour of model projection and contour pixels from image.

- **Deformation Reconstruction** Modify the given code of conventional embedded deformation graph to recover aortic 3D deformation.

- **Correspondence Improvement (optional)** You can iteratively update the correspondence to improve the reconstruction result.

- **Pre-operative Model Segmentation (optional)** We also provide the corresponding CT data, with which you can segment your own 3D pre-operative model using ITK-Snap and Meshlab.

References

[1] Y. Zhang, L. Zhao, and S. Huang, Aortic 3d deformation reconstruction using 2d x-ray fluoroscopy and 3d pre-operative data for endovascular interventions, in 2020 IEEE International Conference on Robotics and Automation (ICRA). IEEE, 2020, pp. 2393-2399.