

PLUS Model Catalog: A library of 3D-printable models

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Introduction: 3D-printable tools are ubiquitous in computer-assisted interventions; they are used in a variety of tasks, such as calibration, treatment planning, simulation, and instrument tracking. Previously, we have created the Public Library for Ultrasound (PLUS, www.PlusToolkit.org), a free open-source software platform to support the development of ultrasound-guided intervention application [1]. We enhanced the PLUS Toolkit with an online file library of 3D-printable models for public access and support, as presented in this paper.

Methods: Computer-Aided Design (CAD) software tools, SolidWorks (www.SolidWorks.com) and FreeCAD (www.FreeCADWeb.org), are used to create models of various tools and devices frequently used in computer-assisted intervention applications. Both the source files and STereoLithography (STL) files for the models are listed in a Model Catalog at the PLUS main distribution site (www.PlusToolkit.org). Images and descriptions accompanied the files for simplicity and ease of use. A static HTML page of the catalog automatically updates nightly with the most recent content, allowing the public to download and use the most recent versions of the models for free. The models, with their dimensions and properties, can also be directly imported into 3D Slicer (www.Slicer.org) using the PLUS Model Catalog browser module of the SlicerIGT (www.SlicerIGT.org) extension.

Results: The library currently contains 34 models, while more are being added on a regular basis and upon user request. The PLUS Toolkit has been downloaded approximately 1,500 times per year. It is emerging as a widely used platform in computer-assisted intervention research, and currently has been cited over 70 times, according to Google Scholar. Most PLUS users access the Model Catalog as a resource for tracking fixtures and other 3D-printable surgical tools. The majority of PLUS users have tracked ultrasound that they calibrate with a 3D-printed phantom in Model Catalog (Fig. 1). Other frequently used catalog items include fixtures to mount position-tracking sensors to surgical tools (Fig. 2). Items from the Model Catalog are conveniently inserted into 3D Slicer-based applications, as shown in the navigation scene below with a tracked ultrasound, needle, and spine, all of which are from the Model Catalog (Fig. 3).

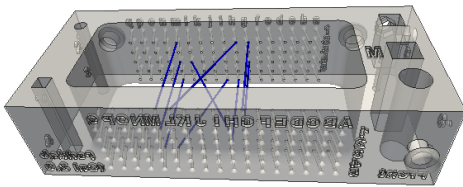


Fig. 1. Ultrasound calibration phantom [2].

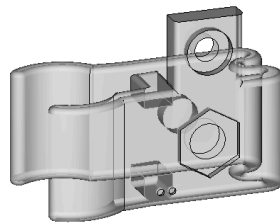


Fig. 2. Electromagnetic tracking sensor holder for electro-surgery cautery device [3].

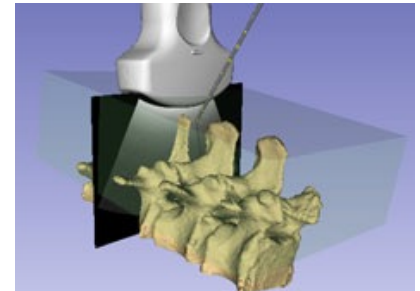


Fig. 3. 3D Slicer navigation scene with catalog models of tracked ultrasound, needle, and spine [1].

Conclusion: The PLUS Model Catalog contributes to the PLUS Toolkit (www.PlusToolkit.org) in promoting rapid development and clinical translation of computer-assisted intervention applications. The catalog is continuously expanded with new and revised models.

References:

- [1] Lasso *et al.* "Plus: Open-source toolkit for ultrasound-guided intervention systems", IEEE TBME 2014
- [2] Carbajal *et al.* "Improving N-wire phantom-based freehand ultrasound calibration", IJCARS 2013
- [3] Ungi *et al.* "Navigated Breast Tumor Excision Using Electromagnetically Tracked Ultrasound and Surgical Instruments", IEEE TBME 2016