Evolving Needs of a Medical 3D Modeling Database, From 3D Print to Extended Reality (XR)

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Purpose of this Poster

- Inform the reader of the existence and purpose of NIH 3D
- Inform the reader of the current state of 3D modeling (3D Print versus XR applications)
- Educate the reader on 3D file formats and categorization as relevant to a digital database
- Recruit interested medical 3D modelers
- Empower 3D modelers to get involved
- Describe the impact of an open repository for biomedical 3D visualization assets

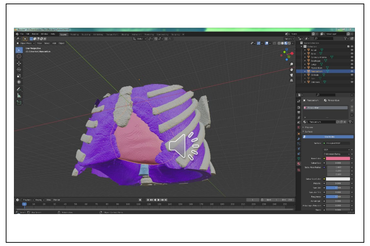
Purpose of NIH 3D

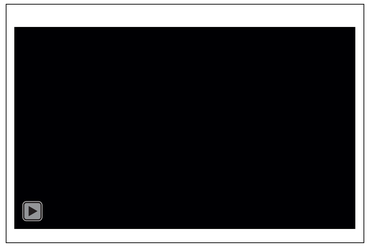
- NIH 3D is a resource from the National Institute of Allergy and Infectious Diseases to provide an open, community-driven portal to download, share, and create bioscientific and medical 3D models for 3D printing and interactive 3D visualization, including virtual and augmented reality.
- NIH 3D will be launched in 2022 as the successor to the NIH 3D Print Exchange (3DPX, https://3dprint.nih.gov).
- UICOMP has partnered with NIAID since 2014 to drive new features and expand utility of 3DPX, and UICOMP research and development in 3D modeling is a critical component in the evolution to NIH 3D
- The goal of this work is to unify and crowd source expertise in biomedical 3D modeling to the benefit of the public through open source file sharing.

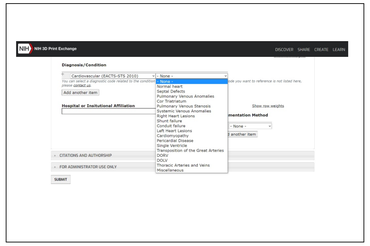
3D Models

- UICOMP has generated close to 300 models for the purpose of surgical planning in 3D. The first 58 were physically printed, but since 2017, all surgical planning has been performed in VR. Figure 1
- UICOMP surgeons have opted for VR due to improved mental representation of the surgical anatomy. This format introduced new components which are to be addressed in NIH 3D, such as how to manage and display transparent model surfaces that give users "Superman X-Ray vision" to see inside complex human anatomy.
- STL has been the standard for 3D printing, but has many limitations; OBJ, FBX, X3D, and glTF are preferred for visualization of models with multiple segments like skin, bone, myocardium, lung. Figure 3 (glTF representation of multiple segments with transparency)
- Third party software remains a necessity, here Blender is utilized to colorize and combine the various segments (skin, bone, myocardium, lung) of the single glTF file. Figure 2
- glTF is emerging as the preferred format for interoperable 3D modeling across the web and in various 3D modeling tools; NIH 3D will use glTF as the primary format for in-browser and web-based VR.

Category	Numbers
Congenital Cardiac Cases (DCM $37K per case)	147
Pediatric Surgical Oncology	13
Surgical Oncology	11
Radiation Oncology	5
Brain Tumors	16
General Cases (early work without a designation)	58
External Cases*	40
Total	290
NRDR (beginning 2020)	29
CPT Code Dropped (beginning 2020)	8







Categorization

- NIH 3D (and currently, 3DPX) incorporate rich metadata descriptors to add value to the models and enhance curation and querying of the database.
- CPT codes are inadequate for labeling models, and taxonomies from specialty fields are needed; For example, cases of Congenital Heart Disease can be labeled with terms standardized by the Society of Thoracic Surgeons (STS) database to provide categorical and relevant search capabilities. Figure 4
- Generic 3D model databases such as Sketchfab, CG Trader, Thingaverse, and TurboSquid among others are not focused on the sharing of scientific data therefore, scientific 3D modelers should feel compelled to support and improve the collective expertise within NIH 3D.
- Exploration of other medically relevant databases will require community support and input. (current pediatric HemOnc databases are not open source)

How to Support NIH3D

- The current 3DPX database hosts over 10,000 entries including 540 medical models; UICOMP has contributed over 100 3D-printable entries and is continuing to add…
- Users across the globe can access the models for free to use for 3D printing and visualization, including VR.

Impact and Future Work

- A repository dedicated to biomedical 3D models has powerful education and clinical implications. As such, the public access sharing of a diverse body of deidentified and HIPAA compliant models will maximize the benefits of the database.
- NIH 3D will incorporate digital object identifiers for published models, to encourage scholarly use. (Journal Links)
- The ultimate value of the repository will be derived from the contributions of many researchers and clinicians.
- To Date, over 10,000 congenital heart models have been downloaded from this database. Please consider joining the effort.
- If you seek a 3D model for surgical planning, utilize the QR code in the corner to gain access to the free segmentation service offered up by Jump Simulation.

References

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- Coakley MF, et al. The NIH 3D Print Exchange: A Public Resource for Bioscientific and Biomedical 3D Prints. 3D Printing and Additive Manufacturing. 2014 Sept 1. PMC4981148
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jumpsimulation.org/segmentation