Title: Voxel printing of Neuroimaging

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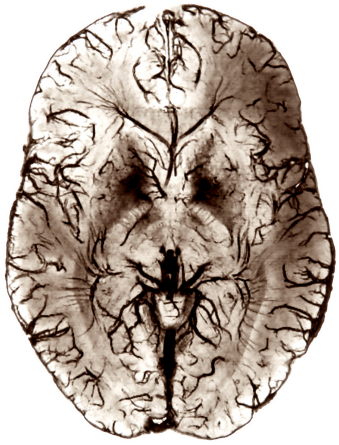
3D printing is becoming a widespread and useful technology in medicine with applications in simulation, teaching, surgical planning and patient-specific prostheses. Typically, in order to 3D print neuroimaging data, anatomical areas of interest must first be identified on individual 2D slices, then isolated (either manually or via thresholding), and then converted to a 3D mesh. This time-consuming 'segmentation' typically requires commercial software and, in forming this 3D mesh, the rest of the scan data is lost and reduced to a binary representation i.e. either outside or inside the anatomical area of interest. Furthermore, the size of structures may be over or underestimated. Voxels (volume pixels) represent a value on a 3-dimensional regular grid, with 3D printing outputting these values to a 3D printed model. Voxel printing can obviate the need for segmentation and 3D mesh generation, with effectively lossless printing of whole neuroimaging datasets. Here, 7T MRI brain images were converted to bitmap images and printed on a Stratasys 760M printer at the printer's native resolution. SimpleITK, an open source library for imaging analysis, was used to interpolate between imaging slices to achieve the required 800dpi slice resolution; a Floyd-Steinberg dithering algorithm was used to convert images to two pixel values representing clear and opaque resin. The resulting printed model has preservation of the delicate cerebral vasculature and differentiation between grey / white matter (see images below). Voxel printing of neuroimaging therefore offers exciting possibilities with more accurate visualisation of complex neurological structures. (Up to 250 words)



Biography

Dr. Luke Hale is a doctor and multi-disciplinary designer working in London, UK. He is currently working as an emergency medicine doctor in East London and is a visiting researcher at the UCL Institute of Surgical and Interventional Science and the Royal National Orthopaedic Hospital. (Up to 100 words)







Photos of voxel printed 7T MRI image

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