Maximum intensity projection

Maximum intensity projection (MIP) is a visualization technique commonly used in medical imaging to display the maximum intensity value along the line of sight in a 3D dataset. This is achieved by projecting a 3D image onto a 2D plane, with the maximum intensity value at each point being displayed on the 2D image. MIP is particularly useful for highlighting features such as blood vessels and other tubular structures in medical images.

Advanced visualization techniques such as maximum intensity projection (MIP) and volume rendering (VR) are useful for evaluating neurovascular anatomy on CT angiography (CTA) of the brain; however, interference from surrounding osseous anatomy is common. Existing methods for removing bone from CTA images are limited in scope and/or accuracy, particularly at the skull base. We present a new brain CTA bone removal tool, which addresses many of these limitations. A deep convolutional neural network was designed and trained for bone removal using 72 brain CTAs. The model was tested on 15 CTAs from the same data source and 17 CTAs from an independent external dataset. Bone removal accuracy was assessed quantitatively, by comparing automated segmentation results to manual segmentations, and qualitatively by evaluating VR visualization of the carotid siphons compared to an existing method for automated bone removal. Average Dice overlap between automated and manual segmentations from the internal and external test datasets were 0.986 and 0.979 respectively. This was superior compared to a publicly available noncontrast head CT bone removal algorithm which had a Dice overlap of 0.947 (internal dataset) and 0.938 (external dataset). Our algorithm yielded better VR visualization of the carotid siphons than the publicly available bone removal tool in 14 out of 15 CTAs (93%, chi-square statistic of 22.5, p-value of < 0.00001) from the internal test dataset and 15 out of 17 CTAs (88%, chi-square statistic of 23.1, p-value of < 0.00001) from the external test dataset. Bone removal allowed subjectively superior MIP and VR visualization of vascular anatomy/pathology. The proposed brain CTA bone removal algorithm is rapid, accurate, and allows superior visualization of vascular anatomy and pathology compared to other available techniques and was validated on an independent external dataset [1)].

1)
Isikbay M, Caton MT, Calabrese E. A Deep Learning Approach for Automated Bone Removal from Computed Tomography Angiography of the Brain. J Digit Imaging. 2023 Feb 13. doi: 10.1007/s10278-023-00788-y. Epub ahead of print. PMID: 36781588.