3D Reconstruction of ICF Images Using Neural Networks.

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Inertial Confinement Fusion (ICF) targets have features such as the joint feature and shell asymmetries that produce 3D effects during implosion. X-ray imaging serves as a method to distinguish between materials and densities, thereby unveiling the internal aspherical structures within these double shell targets. In experimental environments such as the National Ignition Facility, the availability X-ray image views is scarce and often limited to no more than a few lines of sight. Mathematical reconstruction of 3D objects from a sparce number of views is ill-posed and often needs constraints that utilize prior information. An encoder-decoder based neural network can implicitly learn these constraints directly from a 3D object and corresponding X-ray image [1]. We use ray tracing to produce synthetic X-ray radiographs, from a known 3D object. Noise is added to the synthetic images using a Generative Adversarial Network, designed to mimic the noise statistics identified in experimental double shell images. A 2D-3D convolutional neural network is trained to produce original 3D object from a single noisy ray-traced projection [2]. We apply this reconstruction process to experimental ICF images to produce 3D models. These 3D models can then be used to extract information such as 3D asymmetries using spherical harmonic methods. We further demonstrate the application of the synthetic generated data to tasks such as image denoising, contour extraction, and image super resolution [3,4].

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