SDFoam: Signed-Distance Foam for explicit surface reconstruction

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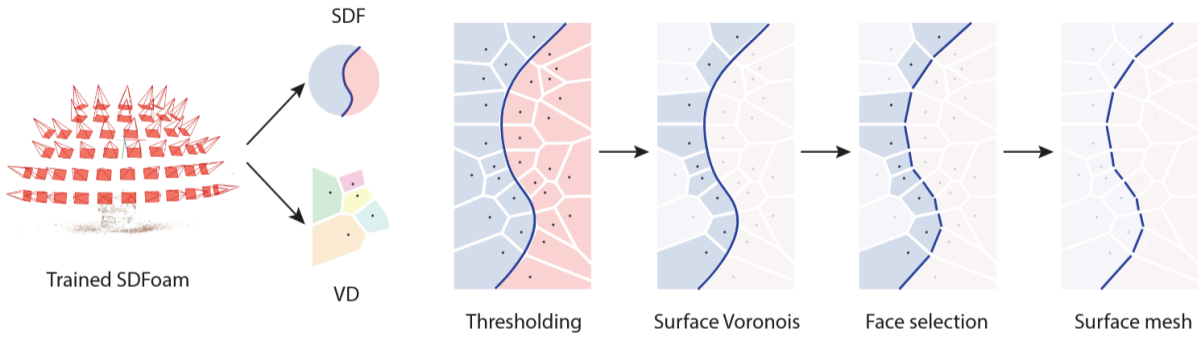

Neural radiance fields (NeRF) have driven impressive progress in view synthesis by using ray-traced volumetric rendering. Splatting-based methods such as 3D Gaussian Splatting (3DGS) provide faster rendering by rasterizing 3D primitives. RadiantFoam (RF) brought ray tracing back, achieving throughput comparable to Gaussian Splatting by organizing radiance with an explicit Voronoi Diagram (VD). Yet, all the mentioned methods still struggle with precise mesh reconstruction. We address this gap by jointly learning an explicit VD with an implicit Signed Distance Field (SDF). The scene is optimized via ray tracing and regularized by an Eikonal objective. The SDF introduces metric-consistent isosurfaces, which, in turn, bias near-surface Voronoi cell faces to align with the zero level set. The resulting model produces crisper, view-consistent surfaces with fewer floaters and improved topology, while preserving photometric quality and maintaining training speed on par with RadiantFoam. Across diverse scenes, our hybrid implicit-explicit formulation, which we name SDFoam, substantially improves mesh reconstruction accuracy (Chamfer distance) with comparable appearance (PSNR, SSIM), without sacrificing efficiency.