AbstractID: 1432 Title: Improvements in Monte Carlo denoising based on batching

Recent studies have demonstrated that Monte Carlo (MC) denoising techniques can reduce computation time significantly. These techniques share the objective of achieving good noise attenuation without causing undesired blurring (biasing) of the dose distribution fine details. Methods considered in this study included wavelet, median-adaptive, locally-adaptive curve fitting, anisotropic diffusion, and an iterative noise reduction technique. The various techniques were tested on several 2D and 3D photon beam datasets, including a lung treatment plan. When applied to a single batch, initial results indicated a nearly consistent performance enhancement of 4-6 in variance reduction (and run-time reduction) across the different data sets depending on the noise level. A modest superiority of the adaptive mean-median method was observed for images that have sharp features as in the case of the synthetic data and the lung treatment plan. Combining results based on batches sometimes, though not always, is superior to denoising the cumulative dose image alone. The greatest improvement was seen, when using four batches, by the locally-adaptive curve fitting technique (Kawrakow, Phys Med Biol., 47:3087-103 (2002)), where batching improved variance reduction by a factor of about two. Improvements due to batching are related to the ability of some algorithms to effectively use larger window sizes when the local noise in a particular batch happens to be low.

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