AbstractID: 8740 Title: Temporal filtering of noise in low-dose x-ray fluoroscopy

Purpose: To improve quality of low-dose X-ray fluoroscopic images using statistics-based restoration algorithm so that the patient fluoroscopy can be performed with much reduced radiation dose**.**

Method and Materials: We first studied the noise properties of low-dose X-ray fluoroscopic images through repeated measurements using a Varian Acuity simulator. Noise in X-ray fluoroscopic images can be modeled as Poisson noise plus background electronic Gaussian noise and the mean-variance of the noise can be described by an analytical formula. Based on the noise model in fluoroscopic images, a penalized weighted least-squares (PWLS) objective function was constructed to restore fluoroscopic images acquired with low mAs protocol. Furthermore, the Karhunen-Loève (KL) transform was utilized to consider correlations among neighboring frames of fluoroscopy. The KL transform manipulates a sequence of correlated measurements into an uncorrelated, ordered principle component series and, therefore, provides a unique means for de-correlation, feature extraction and noise reduction. After the KL transform, the regularization parameter in PWLS criterion will be inverse proportional to its corresponding eigenvalue. Such a choice is favorable because the regularization parameter varies adaptively according to the signal-to-noise ratio of that component. A smaller KL eigenvalue is associated with a component having a lower SNR; therefore, a larger regularization value should be used to penalize this noisier data.

Results: We tested the proposed K-L domain PWLS noise reduction algorithm using an anthropomorphic chest phantom. Low-dose fluoroscopic images were acquired with X-ray tube current of 10 mA and duration of x-ray pulse 2 ms. In the image restored by the proposed KL domain PWLS algorithm, noise is greatly suppressed while fine structures are well preserved.

Conclusion: Experiment studies show that image quality of low-dose X-ray fluoroscopic image can be dramatically improved by using statistics-based temporal filtration. The proposed noise reduction technique shows potential for dose reduction of X-ray fluoroscopy.