

**Purpose:** We aim to develop model-based tomographic reconstruction methods that incorporate knowledge about known components (e.g. implants, surgical tools) within the scanning field. Inclusion of such knowledge as part of the reconstruction approach should benefit image quality in situations where there is missing data or where noise levels are particularly high. While the proposed reconstruction framework is general, in this work we focus on metallic implants and elimination of streak artifacts associated with those components.

**Methods:** We have developed a novel model-based reconstruction technique that parameterizes the image volume as the combination of the underlying background attenuation and an arbitrary number of known components whose attenuation profile is known but whose locations and orientations are unknown. Adopting a tomographic forward model that includes noise allows for derivation of a penalized-likelihood objective function. Maximization of this objective for the unknown registration and attenuation parameters yields a joint estimate of the object and the position and pose of each known component. We have developed optimization routines to solve this model-based objective based on an alternating maximization scheme.

**Results:** The proposed reconstruction method has been applied to spine imaging where there are pedicle screws in the imaging field. We compare our novel approach with reconstructions formed from traditional filtered backprojection and ordinary penalized-likelihood approaches. We find that in the proposed scheme the position and pose of the implants is highly accurate and that streak artifacts associated with the metal implants are greatly reduced.

**Conclusions:** Model-based reconstruction that utilizes information about known components in the object has the potential to significantly improve image quality. While we have demonstrated this for the case of metallic pedicle screw implants, the technique is general and can apply to other scenarios where the (possibly heterogeneous) structure of components are known.