Current image reconstruction methods used in tomographic imaging modalities such as CT were
developed under the assumption that a complete and consistent dataset was acquired during data
acquisition. In practice, however, the acquired data are often not consistent. As a result, the
application of a well-developed image reconstruction algorithm to an inconsistent dataset
generates artifacts in the reconstructed images. Conflicts between classical image reconstruction
theory and the physics involved in the data acquisition procedure motivate us to incorporate the
data consistency information into image reconstruction. In the proposed data consistency driven
image reconstruction framework, a data inconsistency metric was introduced to classify an
acquired dataset into different consistency classes. A conventional single class reconstruction
strategy was generalized to reconstruct multiple consistency classes jointly in a matrix completion
form using the proposed Simultaneous Multiple Artifacts Reduction in Tomographic
RECONstruction algorithm. The proposed framework was applied to improve three-dimensional
cone-beam CT (CBCT) image quality, generate time-resolved CBCT angiography from a single
short-scan data acquisition, and improve the temporal resolution of CBCT by a factor of more than
30-times, so that an average of 7.5 frames per second temporal resolution can be achieved in a
multi-sweep data acquisition protocol. These novel imaging techniques will enable physicians to
improve their toolbox for better clinical care.