Purpose: To develop a novel metal artifacts reduction (MAR) technique through sinogram pre-processing and post-processing techniques.

Methods: The proposed MAR method consists of two steps. In the pre-processing step, we reconstruct a binary image delineating the locations and shapes of metal objects through a non-linear amplification of the sinogram. The boundaries of metallic objects are obtained by using a penalized weighted least-squares (PWLS) algorithm with adequate intensity gradient-controlled. The obtained metal only image with the associate intensity is the metal image model. Forward-projection of the metal image model gives us the metal projection pattern. The sinogram post-processing step includes matching of the metal projection pattern in the projection space, smart subtraction of the metal projection pattern from the original projections and a final smoothing step. The post-processed projections are used to reconstruct the metal artifacts free image through FDK algorithm. A series of experimental studies of a head phantom with different numbers and shapes of metals are performed to evaluate the proposed approach.

Results: The study shows that the proposed method is capable of remarkably reducing metal artifacts, and improving soft-tissue visibility. Even with multiple metal objects inserted, each one of them is identified after the pre-processing step. The accuracy of the metal artifacts free images are within 3 pixels.

Conclusions: The proposed method demonstrates to be effective to achieve metal artifacts free images. The combination of sinogram pre-processing and post-processing provides a viable way of reducing metal artifacts in CT imaging.