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Abstract

X-ray computed tomography (CT) is an important and widespread inspection technique in industrial non-destructive testing. However, large-sized and heavily absorbing objects cause artifacts due to either the lack of penetration of the specimen in specific directions or by having data from only a limited angular range of views. In such cases, valuable information about the specimen is not revealed by the CT measurements alone. Further imaging modalities, such as optical scanning and ultrasonic testing, are able to provide data (such as an edge map) that are complementary to the CT acquisition. In this paper, a superiorization approach (a newly developed method for constrained optimization) is used to incorporate the complementary data into the CT reconstruction; this allows precise localization of edges that are not resolvable from the CT data by itself. Superiorization, as presented in this paper, exploits the fact that the simultaneous algebraic reconstruction technique (SART), often used for CT reconstruction, is resilient to perturbations; i.e., it can be modified to produce an output that is as consistent with the CT measurements as the output of unmodified SART, but is more consistent with the complementary data. The application of this superiorized SART method to measured data of a turbine blade demonstrates a clear improvement in the quality of the reconstructed image.