TOMOSYNTHESIS OF CURVED STRUCTURES
INCORPORATION OF SURFACE INFORMATION

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Statement of the Problem
Laminographic imaging offers a solution to obtain three-dimensional computed tomography images of large semi-planar objects. Such methods omit parts of the full information by acquiring projection data from a limited perspective range.

Goal
We examined the possibilities of acquiring and incorporating surface information into coplanar translational laminography to enhance visibility in tomosynthesis reconstruction and to provide prior knowledge for algebraic reconstruction (ART).

Measurement Setup
The measurements have been performed on an aeronautic flap made from carbon fiber reinforced polymer (CFRP) with bounding box dimensions of $800 \times 160 \times 1200$ mm$^3$. The flap (Figure 1) is made up of an outer shell with one convex and one concave side and five inner spars. The region of interest (ROI) is an area of porosity at one side. We acquired 61 projections on a circular tomosynthesis trajectory with 30° tomosynthesis angle.

Surface Determination
Laminographic acquisitions lack in-depth information of the object due to the incomplete projection data for full 3-D CT. This is why it may be difficult to recognize object boundaries in the reconstructed images. Figure 2 a) shows an in-depth slice of the tomosynthesis reconstruction of the ROI. Only the glass fibers help to estimate the object surface. We use information of the object boundaries to enhance the reconstructed image for better perspicuity. We performed an additional acquisition with markers on the object to identify a series of points on the surface and to estimate the object's boundaries by two-dimensional B-spline surfaces (Figure 2 b)).

Enhancement of Tomosynthesis
We enhance the tomosynthesis image by masking with the estimated surface. The now known object boundaries also allow us to planarize the reconstructed image in order to inspect the object slice by slice parallel to the material layers. Figure 3 shows one slice of the image before and after planarization. The material layer becomes visible after planarization and one can recognize the porosity in the layer.

Regularization of Algebraic Reconstruction
Missing perspective information affects ART so that the attenuation coefficients get blurred in depth through the volume. Attenuation information in the object gets distorted. Providing the surface information as prior knowledge forces the reconstruction to keep the attenuation values within the object boundaries and enhances the reconstruction (Figure 4).

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