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Data Article

X-ray tomography data of White Etching Cracks (WEC)

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A R T I C L E I N F O

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A B S T R A C T

This data article contains lab-based micro-computed tomography (μCT) data of cracks and crack networks in 4 different bearings, mainly from wind turbines, which formed the basis for the crack analysis reported in Danielsen et al. (Danielsen et al., 2019).

1. Data

The data presented in this paper consist of 5 X-ray tomography datasets of crack networks found in 4 different types of bearings. Sample A is an axial bearing from an FE8 type test rig and two volumes have been scanned on this sample. These scans are labelled Sample A1 and Sample A2 (Fig. 1 and Fig. 2). Sample B is a tapered bearing (Fig. 3), Sample C is a ball bearing (Fig. 4) and Sample D is a radial bearing (Fig. 5). Samples B, C and D are all from wind turbine bearings. The original raceway is marked with an arrow while the running direction is unknown. The scan parameters for all the scans are listed in Table 1 and the datasets are all in 3D tif format.

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Specifications Table

Subject	Metals and Alloys
Specific subject area	X-ray tomography of White etching cracks (WEC) in wind turbine bearing
Type of data	X-ray tomography data
How data were acquired	Laboratory X-ray tomography scanner (Zeiss Xradia 520 Versa)
Data format	3D tif images
Parameters for data collection	The bearings were cut into size before scanning with the experimental settings listed in Table 1
Description of data collection	Absorption X-ray tomography and reconstruction by standard filtered back projecting
Data source location	Roskilde, Denmark, Latitude: 55.695343, Longitude: 12.08921
Data accessibility	The data is available online at: https://doi.org/10.5281/zenodo.3237622 https://doi.org/10.5281/zenodo.3258273 https://doi.org/10.5281/zenodo.3258682 https://doi.org/10.5281/zenodo.3259000
Related research article	The datasets presented in this paper have been used in [1] to determine cracks and crack networks in 4 different types of wind turbine bearings. [1] H.K. Danielsen, S. Fæster, A.J. Carrasco, K.V. Dahl, F.G. Guzmán, P. Sauvage, G. Jacobs, 3D X-ray Computerized Tomography of White Etching Cracks (WEC), Materials Characterization 150 (2019) 78–87. https://doi.org/10.1016/j.matchar.2019.01.032

Value of the Data

- The datasets contain detailed 3D information of crack formation in different types of wind turbine bearings, showing different crack morphology types in three dimensions.
- The datasets makes it possible to observe damage progression inside the specimens in 3D, which could enhance the understanding of the damage mechanisms and initiation.
- The datasets can serve as input for 3D fracture mechanics models dealing with the damage progression of cracks in bearings.
- The datasets can be used for developing better segmentation algorithm for determination of crack networks.

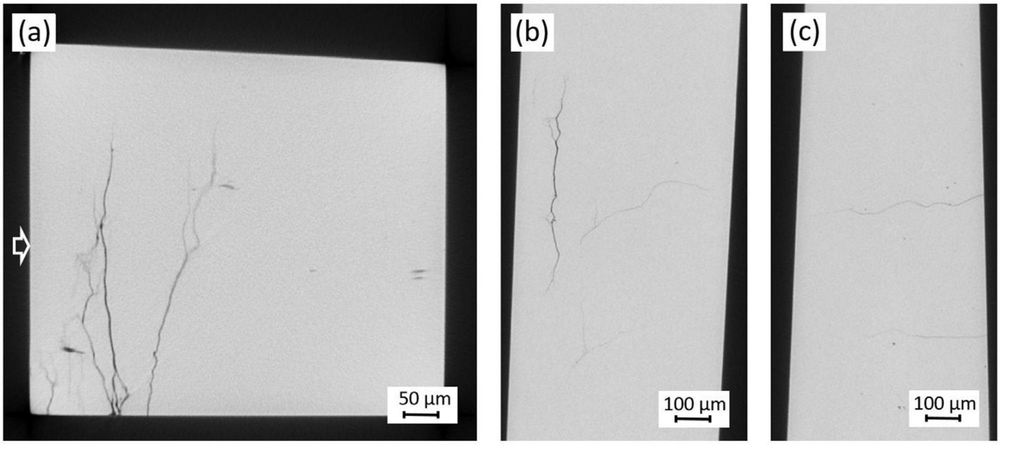

Fig. 1. Sample A1. Cross sections through the middle of the dataset in the directions (a) xy, (b) xz and (c) yz. The white arrow in (a) indicate the original raceway.

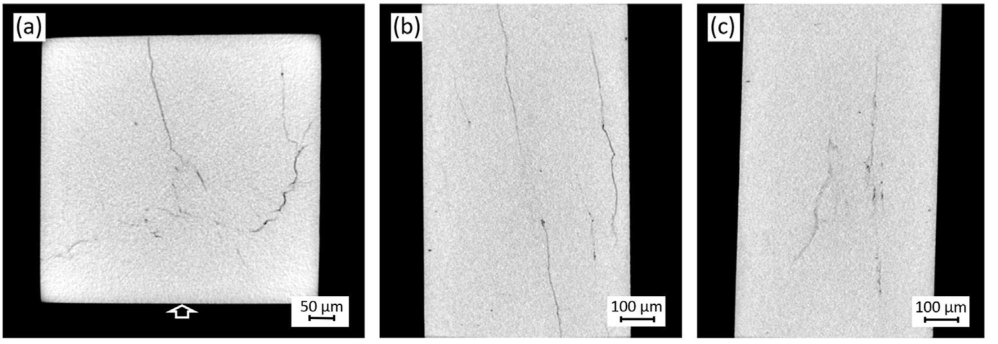

Fig. 2. Sample A2. Cross sections through the middle of the dataset in the directions (a) xy, (b) xz and (c) yz. The white arrow in (a) indicate the original raceway.

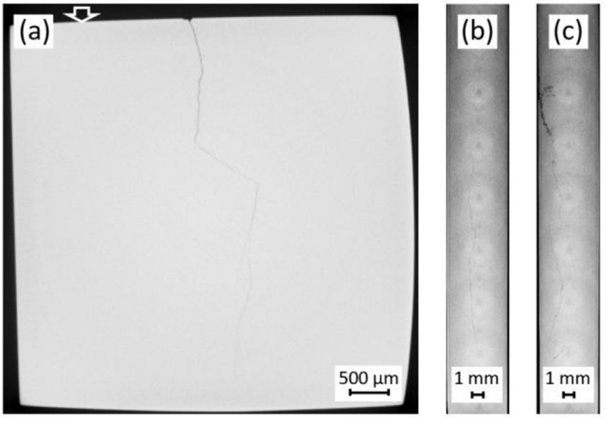

Fig. 3. Sample B. Cross sections through the middle of the dataset in the directions (a) xy, (b) xz and (c) yz. The white arrow in (a) indicate the original raceway.

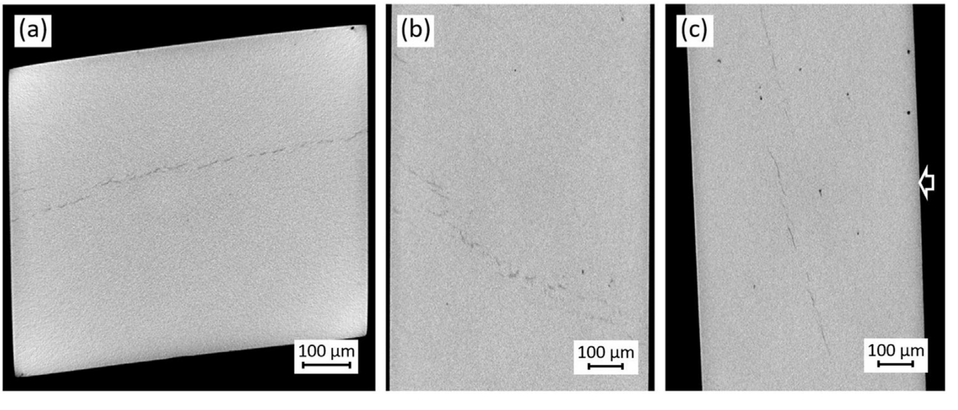

Fig. 4. Sample C. Cross sections through the middle of the dataset in the directions (a) xy, (b) xz and (c) yz. The white arrow in (c) indicate the original raceway.

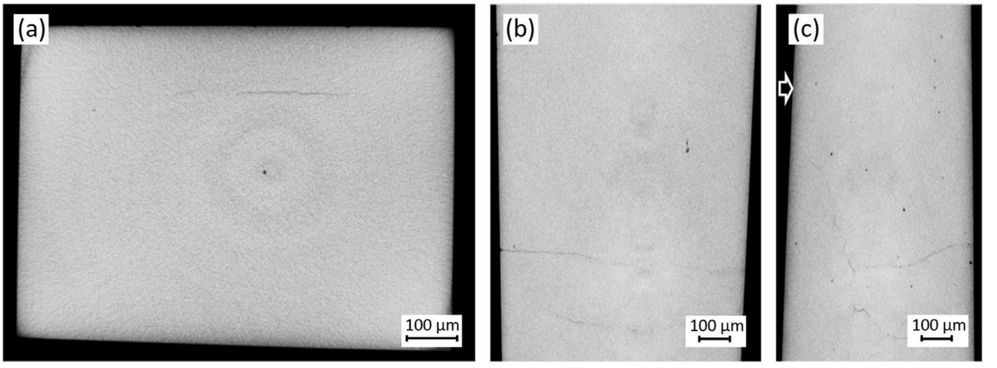

Fig. 5. Sample D. Cross sections through the middle of the dataset in the directions (a) xy, (b) xz and (c) yz. The white arrow in (c) indicate the original raceway.

Table 1
X-ray tomography settings.

Parameter	Sample A1	Sample A2	Sample B	Sample C	Sample D
	Axial Bearing	Axial bearing	Tapered bearing	Ball Bearing	Radial bearing
Optical magnification	4X	4X	4X	4X	4X
Source to sample distance (mm)	8.18	11.02	15.10	8.10	7.87
Detector to sample distance (mm)	31.15	65.00	115.04	37.27	33.00
Exposure time (sec)	10	10	10	15	20
No. of projections	4001	1601	3001	3201	3201
Rotation	360°	360	360°	360°	360°
Accelerating voltage (kV)	80	90	160	80	90
Binning	1	1	1	1	1
Pixel size (μm)	0.70	0.49	3.96	0.60	0.65
Source filter	LE6	HE1	HE5	LE6	HE2
Stitching	1	1	8	1	1
Reconstruction filter (smooth)	0.7	2.5	1.0	0.7	1.6
Beam hardening correction	0.16	0.16	0.11	0.13	0.16

2. Experimental design, materials, and methods

The specimens that have been scanned consist of four different types of bearings, mainly from wind turbines, that are all containing cracks. The reader is referred to [1] for a detailed description of how the samples were manufactured. The tomography scans were performed on a Zeiss Xradia 520 Versa. The X-ray scanner was equipped with a tungsten target. An acceleration voltage of 30 kV and a power of 10 mA was applied to generate X-rays with energies up to 160 keV. Projections were acquired during a full 360° rotation of the specimens.

The detector size was 2k × 2k and projection images with a binning of 1 were acquired to obtain highest possible resolution. A Feldkamp reconstruction algorithm [2] for cone beam reconstructions was applied resulting in 3D reconstructions with voxel sizes down to 0.49 μm. All relevant scan parameters are listed in Table 1.

Acknowledgments

The data was acquired using the Zeiss Xradia 520 Versa from the DTU Centre for Advanced Structural and Material Testing (CAS-MAT), grant no. VKR023193 from Villum Fonden.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] H.K. Danielsen, S. Fæster, A.J. Carrasco, K.V. Dahl, F.G. Guzmán, P. Sauvage, G. Jacobs, 3D X-ray computerized tomography of white etching cracks (WEC), Mater. Char. 150 (2019) 78–87.
[2] L.A. Feldkamp, L.C. Davis, J.W. Kress, Practical cone-beam algorithm, J. Opt. Soc. Am. A 1 (6) (1984) 612–619.