Grating Interferometry-based Phase MicrotomogMicro of Atherosclerotic Human Arteries

ID 2846052
Author(s) Buscema, Marzia; Holme, Margaret N.; Deyhle, Hans; Schulz, Georg; Schmitz, Ruediger; Thalmann, Peter; Hieber, Simone E.; Chicherova, Natalia; Cattin, Philippe C.; Beckmann, Felix; Herzen, Julia; Weitkamp, Timm; Saxer, Till; Mueller, Bert
Author(s) at UniBasel Cattin, Philippe Claude ;
Year 2014
Title Grating Interferometry-based Phase MicrotomogMicro of Atherosclerotic Human Arteries
Journal Proceedings of SPIE
Volume 9212
Pages / **Article-Number** 12
Keywords Grating interferometry, stenosed human arteries, synchrotron radiation, wall shear stress, joint histogram, phase tomography, heterogeneous soft and hard tissues, three-dimensional visualization and representation
Cardiovascular diseases are the number one cause of death and morbidity in the world. Understanding disease development in terms of lumen morphology and tissue composition of constricted arteries is essential to improve treatment and patient outcome. X-ray tomography non-destructively provides three-dimensional data with micrometer resolution. However, a common problem is simultaneous visualization of soft and hard tissue-containing specimens, such as atherosclerotic human coronary arteries. Unlike absorption-based techniques, where X-ray absorption strongly depends on atomic number and tissue density, phase contrast methods such as grating interferometry have significant advantages as the phase shift is only a linear function of the atomic number. We demonstrate that grating interferometry-based phase tomography is a powerful method to three-dimensionally visualize a variety of anatomical features in atherosclerotic human coronary arteries, including plaque, muscle, fat, and connective tissue. Three formalin-fixed, human coronary arteries were measured using advanced laboratory mu CT. While this technique gives information about plaque morphology, it is extremely challenging to extract the lumen morphology from calcified artery specimens. Therefore, selected regions were measured using grating-based phase tomography, sinograms were treated with a wavelet-Fourier filter to remove ring artifacts, and reconstructed data were processed to allow extraction of vessel lumen morphology. Phase tomography data in combination with conventional laboratory mu CT data of the same specimen shows potential, through use of a joint histogram, to identify more tissue types than either technique alone. Such phase tomography data was also rigidly registered to subsequently decalcified arteries that were histologically sectioned, although the quality of registration was insufficient for joint histogram analysis.
Publisher SPIE
URL http://proceedings.spiedigitallibrary.org/proceeding.aspx?articleid=1916628
edoc-URL http://edoc.unibas.ch/dok/A6348351
Full Text on edoc No;
Digital Object Identifier DOI 10.1117/12.2060443
ISI-Number WOS:000344554400002
Document type (ISI) Proceedings Paper
Additional Information Also published in: Developments in X-Ray Tomography IX : 18 - 20 August

2014, San Diego, California, United States. - Bellingham, Wash. : SPIE, 2014. - 921203