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Titel des Beitrags:
High density resolution synchrotron radiation based x-ray microtomography (SR μCT) for quantitative 3D-morphometrics in zoological sciences

Abstract:
Zoological sciences widely rely on morphological data to reconstruct and understand body structures of animals. The best suitable methods like tomography allow for a direct representation of 3D-structures. In recent years, synchrotron radiation based x-ray microtomography (SR μCT) placed high resolutions to the disposal of morphologists. With the development of highly brilliant and collimated third generation synchrotron sources, phase contrast SR μCT became widely available. A number of scientific contributions stressed the superiority of phase contrast over absorption contrast. However, here we demonstrate the power of high density resolution methods based on absorption-contrast SRμCT for quantitative 3D-measurements of tissues and other delicate bio-structures in zoological sciences. We used beamline BW2 at DORIS III (DESY, Hamburg, Germany) to perform microtomography on tissue and mineral skeletons of marine sponges (Porifera) which were shock frozen and/or fixed in a glutamate osmium tetroxide solution, followed by critical point drying. High density resolution tomographic reconstructions allowed running quantitative 3D-image analyses in Matlab and ImageJ. By applying contrast and shape rule based algorithms we semi-automatically extracted and measured sponge body structures like mineral spicules, elements of the canal system or
tissue structures. This lead to a better understanding of sponge biology: from skeleton functional morphology and internal water flow regimes to body contractility. Our high density resolution based quantitative approach can be applied to a wide variety of biological structures. However, two prerequisites apply: (1) maximum density resolution is necessary; (2) edge effects as seen for example in phase outline contrast SR μCT must not be present. As a consequence, to allow biological sciences to fully exploit the power of SR μCT further increase of density resolution in absorption contrast methods is desirable.