DEVELOPMENT OF A MICROSCOPE STAGE WITH 4 DEGREES OF FREEDOM TO ENABLE CROSS SECTIONAL COMPUTED TOMOGRAPHY IMAGING

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State-of-art medical imaging systems, i.e. MRI, PET and CT, can only give indications regarding the presence of most diseases. To transform these indications into 'proofs', findings need to be verified at the subsequent step of examination of biological material (histological and/or cytological) [1] under the Bright-field (BR) microscope. BR-microscopy has three important limitations [2], 1/ it produces only projection 2D-images, 2/ it has finite depth of field and 3/its resolution is diffraction limited. In this study we present the construction of a microscope stage that will enable 3D sample cross sectional imaging in BR-microscopes. Preliminary simulations of this idea were presented by our group at Focus on Microscopy 2015 [3].

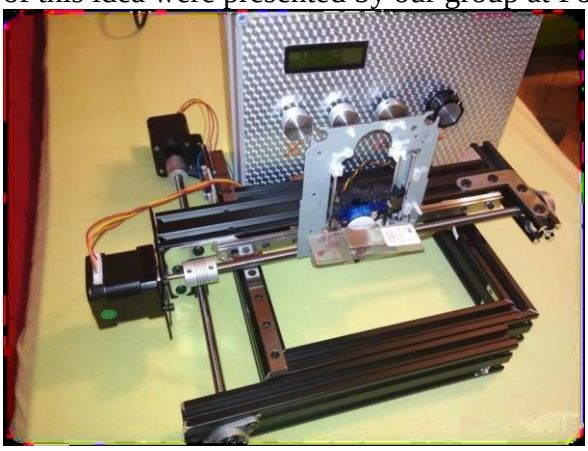
Figure 1: Prototype microscope stage

The prototype stage was constructed from scratch (Figure 1) to enable linear xyz movement and angular rotation with an ARDUINO microprocessor. At each angle of rotation, a back projection image of the sample may be obtained. The cross sectional image may then be reconstructed using the concept of limited angle computed tomography [4]. After reconstructing a stack of successive cross sectional images, the 3D image of the sample may be created. Linear movements were implemented using leadscrews and 3 stepper motors, whereas angular rotation using a microservo motor. The exact coordinates of the sample were monitored by the microprocessor using rotary encoders. The mechanical frame of the stage was built using V-slot aluminum bars. The motors and the microprocessor were supported by a 24V 3A 75W power supply. The proposed microscope stage, merged with the appropriate computed tomography software, may enable the transformation of conventional BR-microscopes into optical tomography instruments for samples of relatively small thicknesses, for which optical light can penetrate creating brightness images. In this way, it would be possible to visualize the 3D structural organization of tissues without the need of physical slicing, providing, the observing physicians with additional, undetected from the standard BR-microscope, information.

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