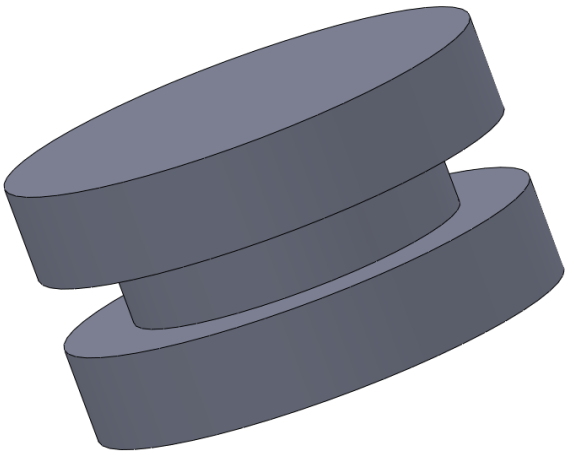
DWI-Phantom „Single Fiber String“

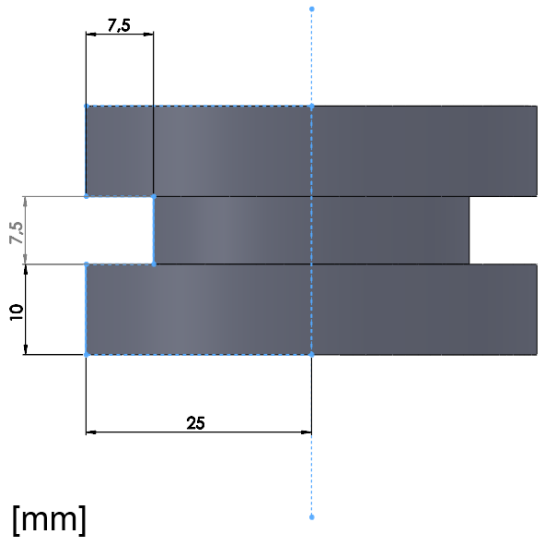
Phantom Design



The phantom consists of a plastic spindle (Polyoximethylene, POM) with a groove of quadratic cross section. A polyester thread is wound onto the spindle filling the groove. Before the thread is wound onto the spindle, it runs through a sodium chloride solution (83 g NaCl per 1 l water). This solution has the same susceptibility as polyester and minimizes mesoscopic B0-field variations. Fibers of 15 µm diameter were used. These water-impermeable fibers restrict the water motion, thus causing anisotropic water diffusion. Depending on the thread-tension, and therefore on the packing density of the fibers, FA values up to 0.9 can be reached. A homogenous pressure on the fibers and thus a uniform FA along the fiber strands is achieved by the circular shape of the spindle.

The quadratic cross section of the groove is
7.5 x 7.5 mm², the phantom diameter is 50 mm.

The phantom is sealed with hot glue in order to prevent drying of the strands. Since the water between the fibers is not sufficient to calibrate a clinical scanner with conventional coils, the phantom is embedded in agarose gel during the final production step. The gel also improves the shimming of the phantom volume.



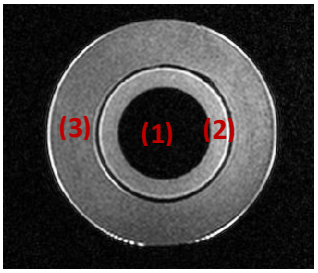
[mm]

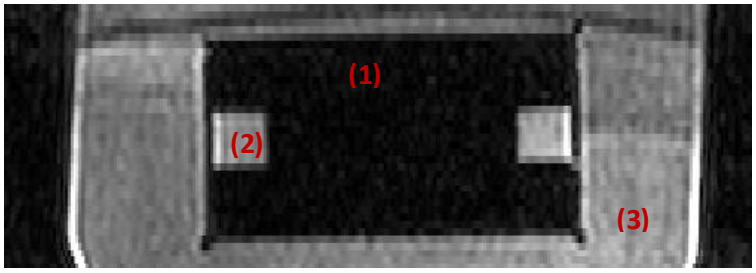
For further information about this phantom see

- Laun FB, Huff S, Stieltjes B. On the effects of dephasing due to local gradients in diffusion tensor imaging experiments: relevance for diffusion tensor imaging fiber phantoms. Magn Reson Imaging 2009;27:541-8.

Parameters and Images:

A high resolution t2-weighted sequence was used to obtain the following images:





(1) Spindle (2) Fibers (3) Agarose gel

The circular spindle (1) consists of plastic and is thus black in the t2-weighted image. The fibers (2) surround the spindle and appear ring-shaped on the left image and as two quadratic cross sections on the right image. The agarose gel (3) surrounds the phantom. The hot glue is visible as a small black ring between fibers (2) and agarose gel (3) in the left image.

This is a basic phantom data set. It was acquired with a diffusion weighted EPI sequence on a 1.5 T Siemens Magnetom Avanto scanner. Only one slice is acquired. Further parameters are: 12 diffusion directions, 5 averages, voxels 2.5 x 2.5 x 10 mm^3, TR 2000 ms, TE 76 ms, b = 0, 1000 s/mm^2, BW = 1488Hz/px. The following tensor data set was reconstructed using MITK: