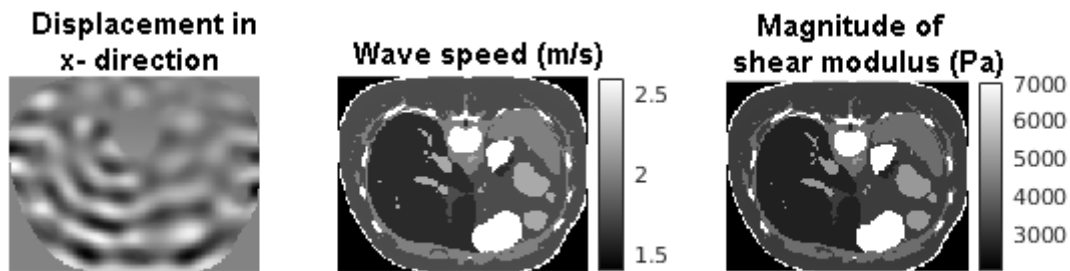# Description for the FEM simulation of a human abdomen

This is an FEM simulation of a human abdomen. This simulation was generated by, and provided to Charité-BIOQIC by, Cemre Ariyurek, National Magnetic Resonance Research Center (UMRAM), Bilkent University, Ankara, Turkey.

Technical Description

A technical description (from Ariyurek et al. NMR in Biomedicine 2020) is as follows:

Using COMSOL Multiphysics, MRE simulations were conducted on a 3D human abdomen model developed from Austin Man v2.4, with voxel size 2 x 2 x 2 mm^3. The Poisson ratio, density and complex Young's moduli were assigned for the segmented tissues. The assigned parameters are given in Table 1. Prescribed displacement was assigned to the surface of the anterior abdomen, and frequency domain analyses were performed, sweeping the excitation frequency from 30 to 48 Hz with 6 Hz increments. Complex displacement fields were exported with 2 mm isotropic voxels.

The data is in 5D complex MATLAB format (3D space, 1D directions, 1D frequencies).

disp.mat: 5D complex displacement

absG.mat: Ground truth for magnitude of the shear modulus |G*|

reG.mat: Ground truth for storage modulus G'

imG.mat: Ground truth for loss Modulus G''

sws.mat: Ground truth for shear wave speed c

Index	Physical Meaning	Dimension Length	Sorting
1	y-coordinate (row index)	136	ascending
2	x-coordinate (column index)	174	ascending
3	z-coordinate (slice index)	20	ascending
4	motion encoding direction index (y,x,z)	3	1: along y-axis 2: along x-axis 3: along z-axis
5	frequency index	4	[30 36 42 48] Hz (ascending)

Image information:
voxel size   [2 2 2] mm
orientation   feet to head

Table 1. Assigned density (ρ), Poisson's ratio (v) and real part of the Young's modulus (Y') parameters for each tissue in the abdomen model. Note that the imaginary part of the Young's modulus (Y'') is set to 0.05Y' (i.e., Y''=0.05Y'') to add damping to the model, where the Young's modulus is given as Y=Y'+iY''.

Tissue Name	Density (kg/m³)	Poisson's ratio	Real Part of the Young's Modulus (kPa)
Colon	1040	0.499	15
Colon Internal	1040	0.499	15
Aorta	1040	0.499	15
Duodenum	1040	0.499	22.7
Blood Vessel	1040	0.499	15
Gall Bladder	1040	0.499	12.5
Cerebro Spinal Fluid	1000	0.499	12
Bone Cortical	1412	0.220	2400
Bone Marrow	1412	0.220	2400
Liver	1040	0.499	8
Peritoneal Cavity	1040	0.499	12.5
Cartilage	1040	0.499	12.5
Lung Inflated	400	0.430	3
Fat	1040	0.499	9.6
Pancreas	1040	0.499	8
Small Intestine	1040	0.499	22.7
Small Intestine Internal	1040	0.499	22.7
Muscle	1040	0.499	9.6
Diaphragm	1040	0.499	12.5
Spinal Cord	1040	0.499	8
Spleen	1040	0.499	12.5
Nerve	1040	0.499	12.5
Stomach	1040	0.499	22.7
Stomach Internal	1040	0.499	22.7
Skin Dry	1130	0.420	101.2
Distal convoluted tubule	1040	0.499	12.5
Tendon	1040	0.499	12.5