Short Manual for using the Matlab script *DECTDec* for three-material decomposition based on dual energy microCT scanning

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This short manual for using our MATLAB script *DECTDec.m* is a supplement to the publication "Microscopic dual energy CT (microDECT): a flexible tool for isotropic multi-channel imaging of biological ex vivo specimens" (Handschuh et al, 201?). *DECTDec.m* performs a three-material decomposition based on dual energy microCT scanning, similar to the approach initially described by Badea et al (2012).

If you use this code, please cite as:

Handschuh , S., Beisser, C., Ruthensteiner, B., and B. D. Metscher (201?): *Microscopic dual energy CT (microDECT): a flexible tool for isotropic multi-channel imaging of biological ex vivo specimens*. Journal, Issue, Pages.

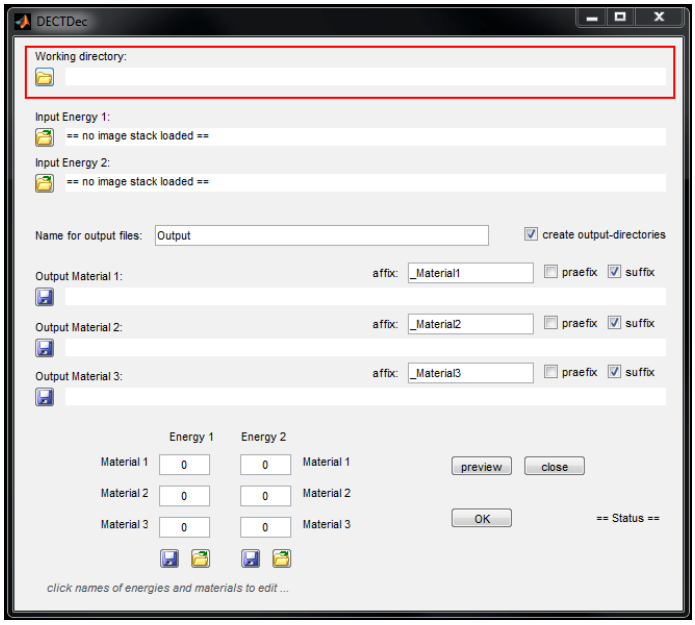
For testing the program, there is a directory named *Test Data* that contains example images for two specimens, an I_2KI-stained head of an adult mouse and a PMA-stained head of a juvenile sturgeon. All information on sample preparation and microCT image acquisition is given in the above-mentioned publication. All decomposition attenuation values (CT numbers) are also listed in this publication, (**table 2**). Decomposition attenuation values for the respective scan energies and materials are also saved in the specimen folders as *.mat files.

Before getting started:

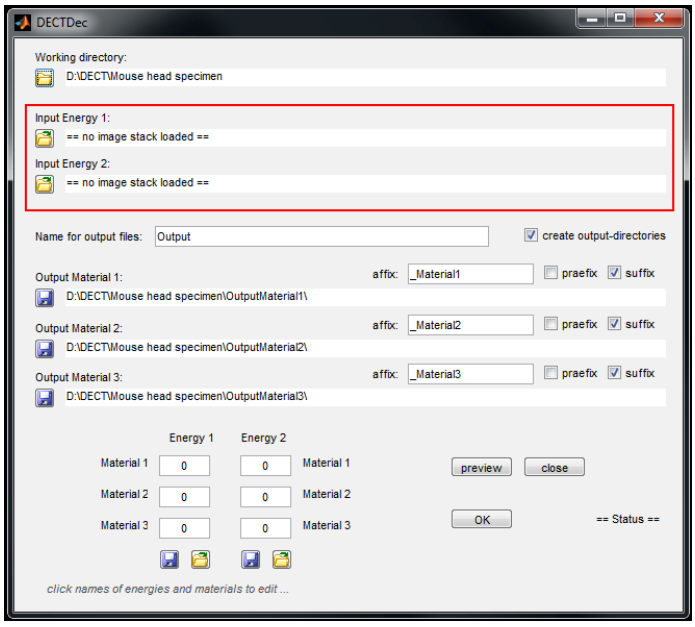
The prerequisite for using this code are two 16bit *.tif sequences in two separate folders, representing the two respective scan energies. They can be in 16 bit signed or 16 bit unsigned format. The two image sequences must have the same X-Y-Z dimensions, and should have been accurately registered using some volume image registration algorithm.

Step-by-step description on how to use the *DECDec.m* program:

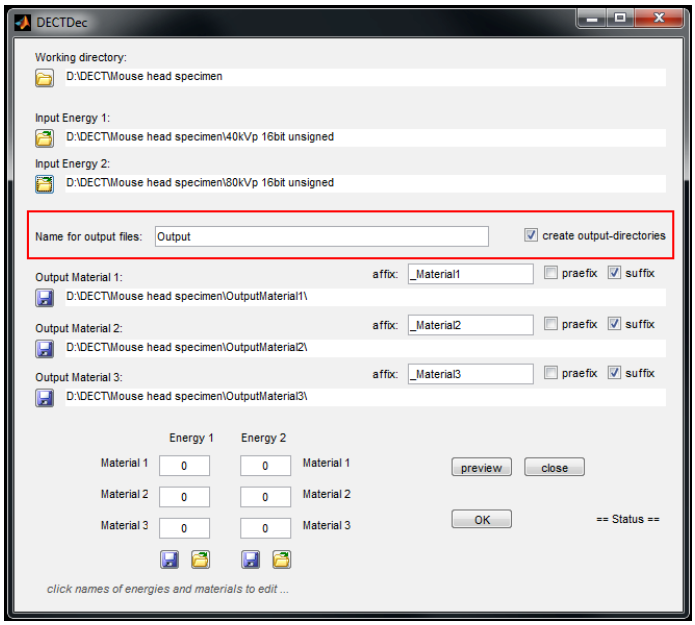
-1- Choose the working directory. This directory should contain already two sub-folders containing the *.tif image sequences of the tow scan energies.



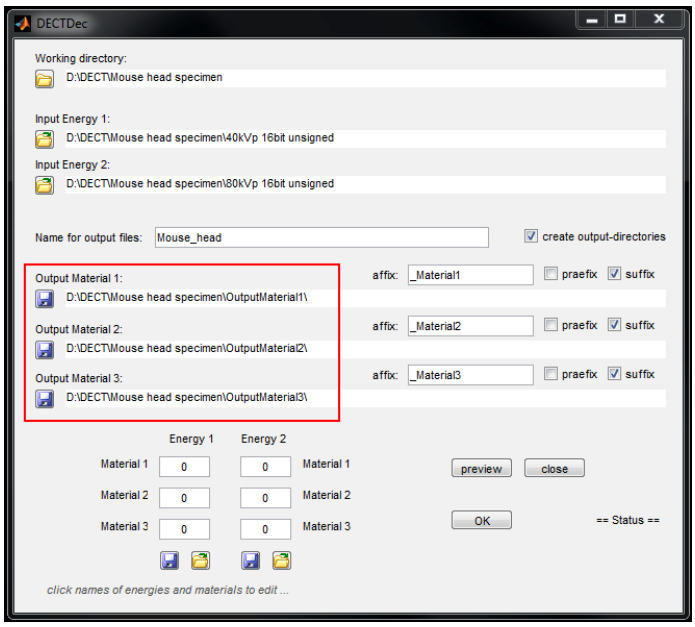
-2- Choose the two folders for energy 1 and 2.



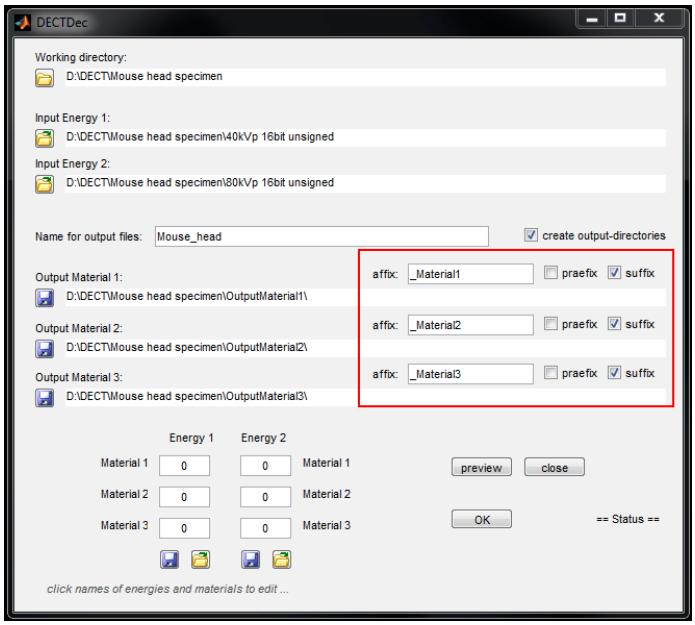
-3- Define the Output file names. If the box “create output-directories” is checked, the program will automatically generate three new sub folders (OutputMaterial1, OuputMaterial2, and OuputMaterial3) for the three decomposited materials within the main working directory.



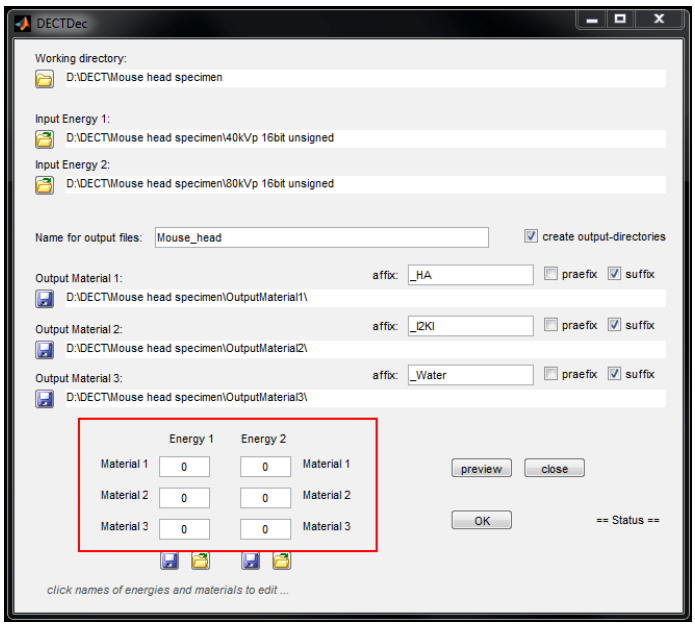
Alternatively, the output directories could be defined manually.



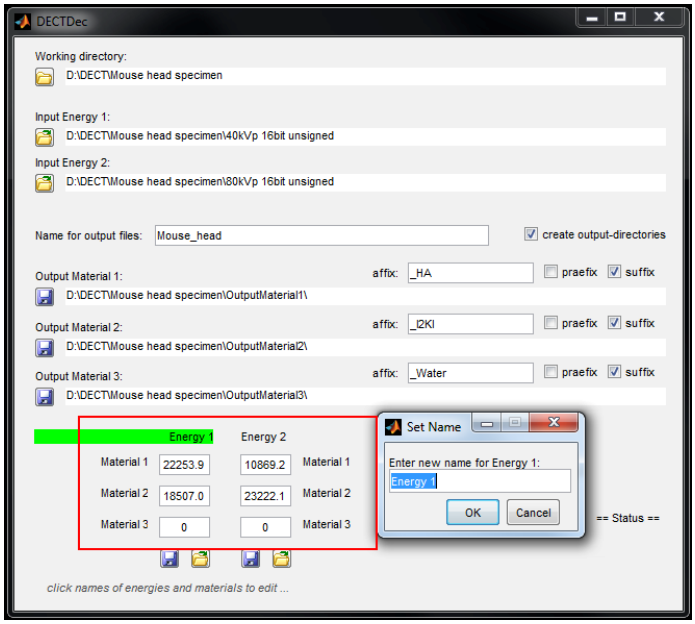
-4- Specify the affix for each of three output materials. By default, the affix will be Material1, Material2, and Material3.



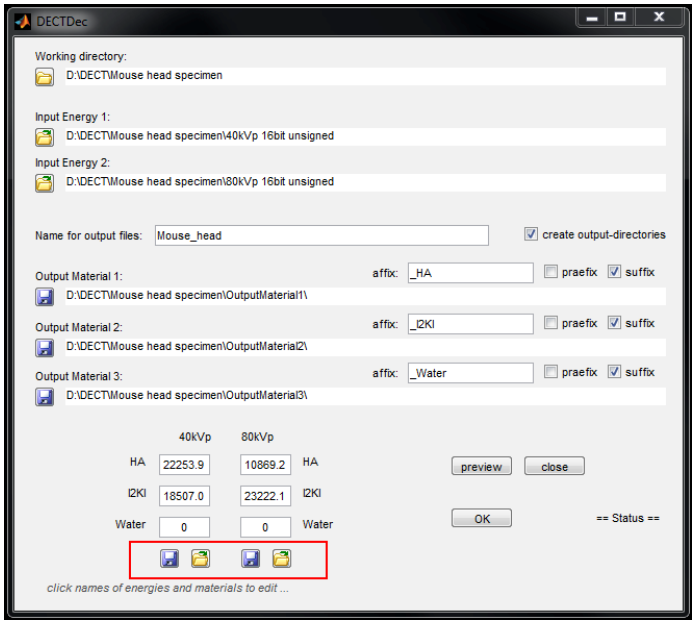
-5- Insert the Decomposition Attenuation values for the three materials at the two scan energies. For getting more information on how these values are calculated, please see Handschuh et al. 201? ().



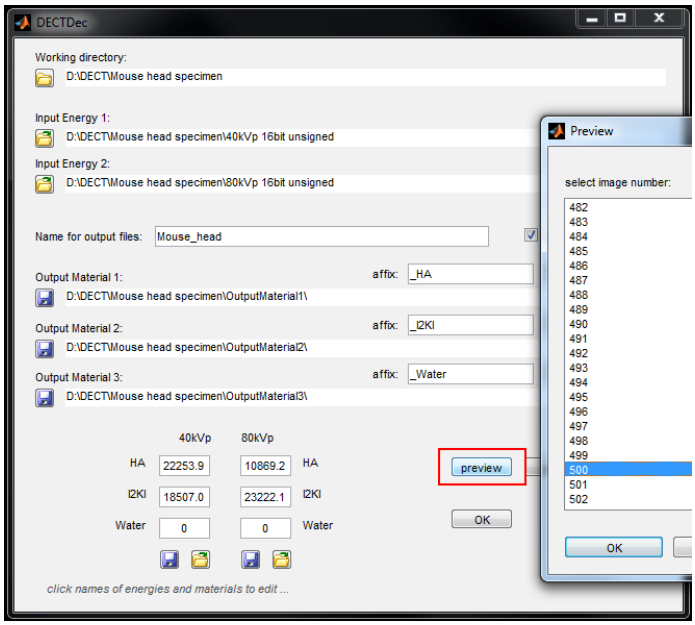
-6- Click the names of energies and materials to edit.



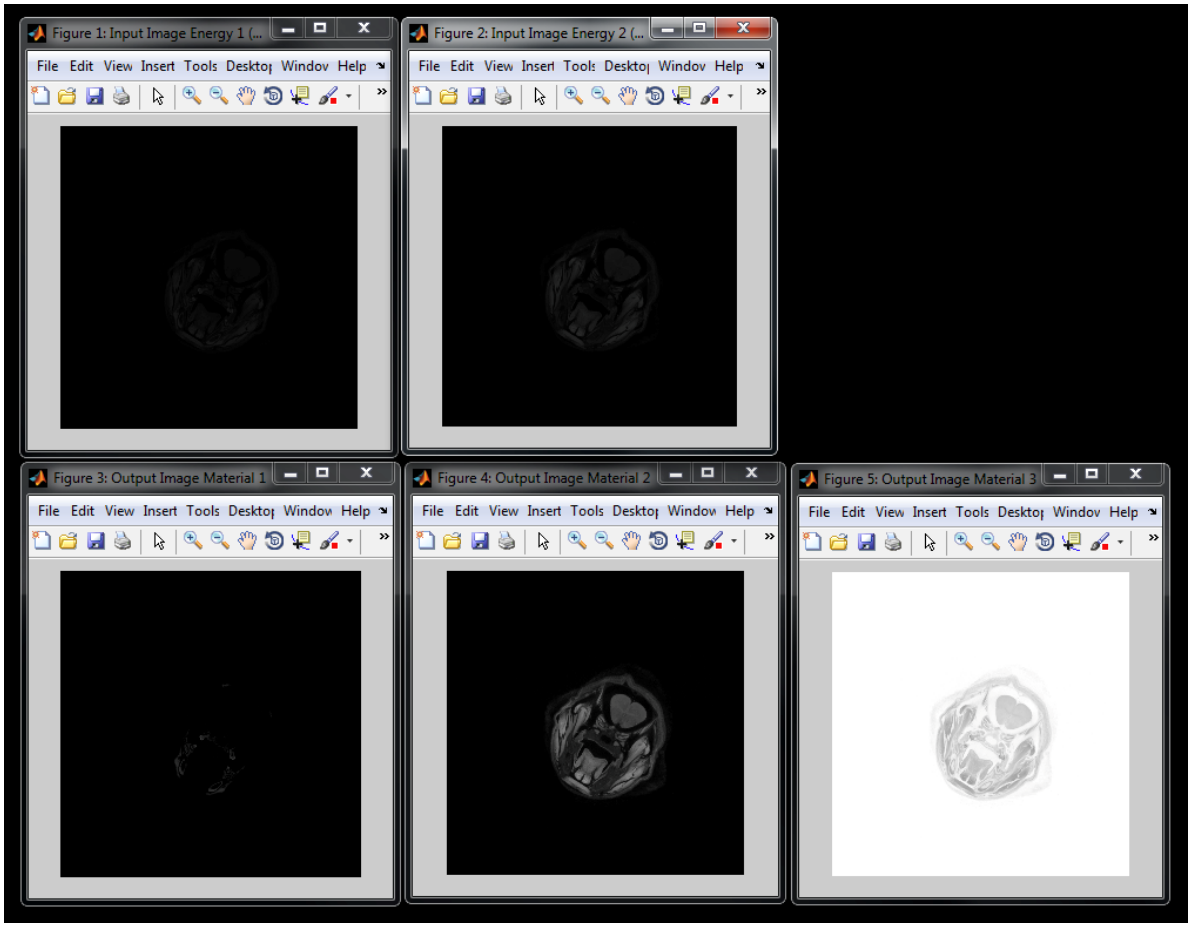
-7- Each energy column containing three decomposition attenuation values can be saved as an *.mat file and later re-opened.



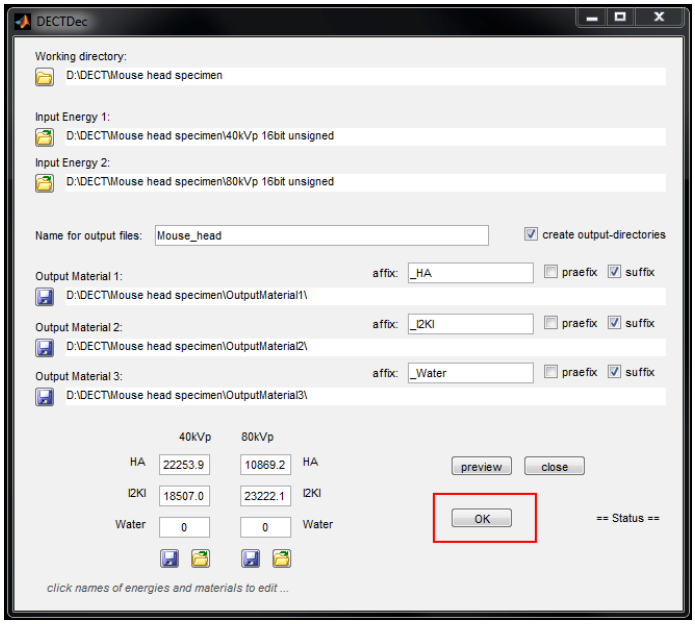
-8- Display a preview image in order to validate the decomposition attenuation values. With the button “preview”, any slice of the image sequence can be chosen.



After selecting an image number, five figures will be generated that show the two input energies and the three decomposited materials. After inspection, the figures can be closed again. With the button “close”, all figures can be closed at once.



-9- Press “OK” to run the decomposition procedure for the whole image volume.



References

Badea, C.T., Guo, X., Clark, D., Johnston, S.M., Marshall, C.D. & Piantadosi, C.A. 2012 Dual-energy micro-CT of the rodent lung. Am J Physiol Lung Cell Mol Physiol 302, L1088-1097.

Handschuh , S., Beisser, C. J., Ruthensteiner, B., and B. D. Metscher (2017): Microscopic dual energy CT (microDECT): a flexible tool for isotropic multi-channel imaging of biological ex vivo specimens. Journal, Issue, Pages.