BME 8730

Fall 2019

Jensen’s FIELD II program

FIELDII is the de facto standard in linear diffraction modeling in medical ultrasound research. It isn’t especially efficient but it is very widely used and accepted. Thus, it makes publishing new work easier if it is based on a well-accepted standard than some one-off Matlab model that isn’t well known (e.g. our own homemade code we used previously)

Go through the FIELDII download. Take care to set up your directories.

Main page:

<http://field-ii.dk/>

Download (match to your OS and to your version of Matlab – might not be this version)

<http://field-ii.dk/?./downloading_8_20.html>

Papers:

<http://field-ii.dk/?papers.html>

Key paper – review this paper very closely. Cite this one at a minimum ALWAYS when using FIELDII in publishable work

<http://field-ii.dk/documents/jaj_nbs_uffc_1992.pdf>

User Guide – review this document very closely. It comprehensively describes the full capabilities of the code – extends to modeling fields, speckle modeling, effects of finite sampling rate (i.e. quantization), modeling blood flow situations

<http://field-ii.dk/?users_guide.html>

Using calc\_h, xdc\_piston, xdc\_rectangle (or xdc\_linear\_array – it doesn’t matter too much but the former is more appropriate)

(see the relevant examples in the user guide), extend as per the previous homework and calculate: velocity potential impulse response (i.e. h from calc\_h), pressure impulse response and response when convolved with a sinusoid (I suggest a 10 cycle sinusoid and that you take the amplitude of the envelope mid pulse duration to get the required CW amplitude to go into the field values)

Replicate the following figures:

Lockwood

Figure 3, 6, 7, 8 and 13 (use 10 to 16 sub-elements in each direction by default) (10,10,10,10,10)

For Figures 3 d and f and 6 d show a result using a single sub-element and one where the overall width dimension is divided into 16 sub-elements (the code allows you to select the number of sub-elements in each of width and height in rectangles and the dimension of sub-elements for circular apertures)

For the CW beamplots, you should consider convolving with a long sinusoidal pulse and detecting the peak to peak amplitude near the center of the pulse (to avoid transient effects near the beginning and end) or use an FFT of the impulse response and extract the correct Fourier component. (If one doesn’t work, try the other.) Notice that you need to define a and  to make your code work. It isn’t critical what actual values you use so long as they are consistent and produce the right results.

Replicate the previous array diffraction homework (using our “homemade” array code) using FIELDII for questions 2-6 of that homework. Use xdc\_linear\_array – or other approach of your choice – note the examples near the end of the user guide. You can change the sub-element size to suit your needs – i.e. save time. I suggest you vary the sub-element and verify the presence or absence of impact on final result.

Please try to do as much of the coding yourself but work together to debug (and acknowledge)

Submit, paper or PDF/word doc, figures and code – at least the core code representative for your solutions to each of one Lockwood figure replication and array diffraction replication.