MEDT8007

Simulation Methods in Ultrasound Imaging

Literature

Book

Cobbold, R.S.C., *Foundations of biomedical ultrasound*, Oxford University Press, New York, 2007.

Week 11 (15-19 March 2010)

Calculation methods for linear fields

From Cobbold:
- Chapter 1 lies the basis for many topics covered within the course. At least read through it, quite some of it is also prior knowledge.
- 2.1 Development of the Rayleigh integral (basis for both SIR and ASM, read through)
- 2.2 Spatial Impulse Response (SIR)
- 2.3 Angular Spectrum Method (ASM)
- 3.1 Application of the ASM
- 3.2 Boundary conditions (read through)
- 3.3 Application of the SIR

Recommended literature:
- Jensen, J.A., *Speed-accuracy trade-offs in computing SIRs for simulating medical ultrasound imaging*, J Comput Acoust, vol. 9, no. 3, 2001. (This document is slightly different from the original publication, it has for instance two more figures.)

Scattering and image formation

From Cobbold:
- 5.1-5.3 Scattering from a rigid or compressible sphere
- 5.9 Scattering from a distribution of scatterers and inhomogeneities

Additional literature:
- Torp, H., *Notes on the point spread function in ultrasound imaging*, 2009.

Transducer design

From Cobbold:
- Subsection 1.5 and chapter 6.

Additional literature:

- McKeighen, R.E., *Design guidelines for medical ultrasonic arrays*, Proc SPIE, vol. 3341, no. 2, 1998.

Recommended literature:
- Angelsen, B.A.J., *Ultrasound imaging*, Emantec, Trondheim, 2000. Vol. 1, chapter 2 and 3.

Dynamic objects

From Cobbold:
- Subsection 9.6 and chapter 10, with emphasis on 10.1, 10.2 and 10.8.

Week 18 (3-8 May 2010)

Assignments:

From Cobbold:
- 8.6.1 Contrast media imaging

Alternative linear methods I and II

Additional literature:
- Hergum, T., et al., *Fast ultrasound imaging simulation in K-space*, IEEE Trans Ultrason Ferroelectr Freq Control, vol. 56, no. 6, 2009.
- Gao, H., et al., *A fast convolution-based methodology to simulate 2-D/3-D cardiac ultrasound images*, IEEE Trans Ultrason Ferroelectr Freq Control, vol. 56, no. 2, 2009.

Recommended literature:
- Crosby, J., et al., *The effect of including myocardial anisotropy in simulated ultrasound images of the heart*, IEEE Trans Ultrason Ferroelectr Freq Control, vol. 56, no. 2, 2009.

Advanced beamforming

Additional literature:
- Synnevag, J.F., et al., *Adaptive beamforming applied to medical ultrasound imaging*, IEEE Trans Ultrason Ferroelectr Freq Control, vol. 54, no. 8, 2009.
- Synnevag, J.F., et al., *Benefits of minimum-variance beamforming in medical ultrasound imaging*, IEEE Trans Ultrason Ferroelectr Freq Control, vol. 56, no. 9, 2009.

Wave equations for lossy media

Recommended literature:
- Holm, S., et al., *A unifying fractional wave equation for compressional and shear waves*, J Acoust Soc Am, vol. 127, no. 1, 2010.

Non-linear propagation I and II

From Cobbold:
- Subsection 1.3 (for some additional background) and chapter 4.

Additional literature:
- Torp, H., *Nonlinear wave propagation - A fast 3D simulation method based on quasi-linear approximation of the second harmonic field*, 2005.

Recommended literature:
- Angelsen, B., *Simulation of nonlinear wave equations in GPU*, 2010.

Last update: June 4th, 2010 by Marco M. Voormolen (marco.voormolen@ntnu.no)