EE 462/562 Principles of Medical and Radar Imaging Spring 2012

Lecturer: M. Soumekh
Office: Bell 128 Phone: 645-2422 Office Hours: T, Th 1:00-1:50
Required Background: Signal processing; Fourier analysis
Grading Policy: Assigned projects 100%

References

1. M. Soumekh, *Synthetic Aperture Radar Signal Processing*, Wiley, 1999.
2. M. Soumekh, *Fourier Array Imaging*, Englewood Cliffs, NJ: Prentice Hall, 1994.
3. M. Born and E. Wolf, *Principles of Optics*, 6th edition, New York: Pergamon Press, 1983.
4. J.W. Goodman, *Introduction to Fourier Optics*, New York: McGraw Hill, 1968.
5. P.M. Morse and H. Feshbach, *Methods of Theoretical Physics*, New York: McGraw Hill, Parts 1 and 2, 1953.
6. A. Papoulis, *Systems and Transforms with Applications in Optics,* New York: McGraw Hill, 1968.
7. M.I. Skolnik, *Introduction to Radar Systems,* New York: McGraw Hill, 1980.
8. B.D. Steinberg, *Principles of Aperture and Array System Design*, New York: John Wiley and Sons, 1976.

Tentative Schedule

Range (Echo) Imaging Using Bandwidth: System modeling; imaging (inverse) problem via matched filtering; digital signal processing (implementation) and sampling constraints; imaging via deramping for chirp signals.

Cross-range Imaging Using Aperure: System modeling; imaging problem; digital signal processing (implementation) and sampling constraints; plane wave approximation-based imaging; Fresnel approximation-based imaging; spotlight and stripmap synthetic aperture signals.

Transmitting/Receiving Elements: An element's transmit radiation pattern; transmit-receive radiation pattern; Fourier representation of radiation pattern.

Reflection-Mode Array Imaging: Synthetic aperture radar (SAR): spotlight SAR; stripmap SAR; digital signal processing and imaging in SAR; Phased arrays: dynamic focusing; beamforming; Fourier-based imaging with linearly phased array data; Fourier-based imaging with depth-focused phased array data.

Transmit-Mode Array Imaging: Geometrical optics approximation-based imaging and computerized tomography (CT); approximation-free imaging; a geophysical imaging modality.

Magnetic Resonance Imaging: Spatial frequency coverga eof MR data; spiral scan imaging; data collection strategies and processing for spatio-temporal imaging.

Project Preparation

Each project may invlove certain derivations as well as developing a computer program. You should clearly document your programs by adding appropriate comments within your programs. Moreover, you should also explain the steps you use in your programs on a separate sheet in which you identify how the parameters of the program are chosen and their implications. For example, to synthesize a signal, you should derive the constraints on the sample spacing which leads you to choose the appropriate sample spacing for your signal. Sometimes, it is also useful to use graphs to make your case clear.

Grading Policy

Each assignment has its own weight (maximum point) which depends on its degree of complexity. Your final grade is the sum of all assignments. The following is the final grade assignment based on the percentage of the total grade:

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A: 87-100; A-: 81-86; B+: 76-80; B:71-75; B-: 66-70; C+: 61-65; C: 56-60; C-: 51-55; F: 1-50.

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A: 91-100; A-: 86-90; B+: 81-85; B:76-80; B-: 71-75; C+: 66:70; C: 61-65; F: 1-60.