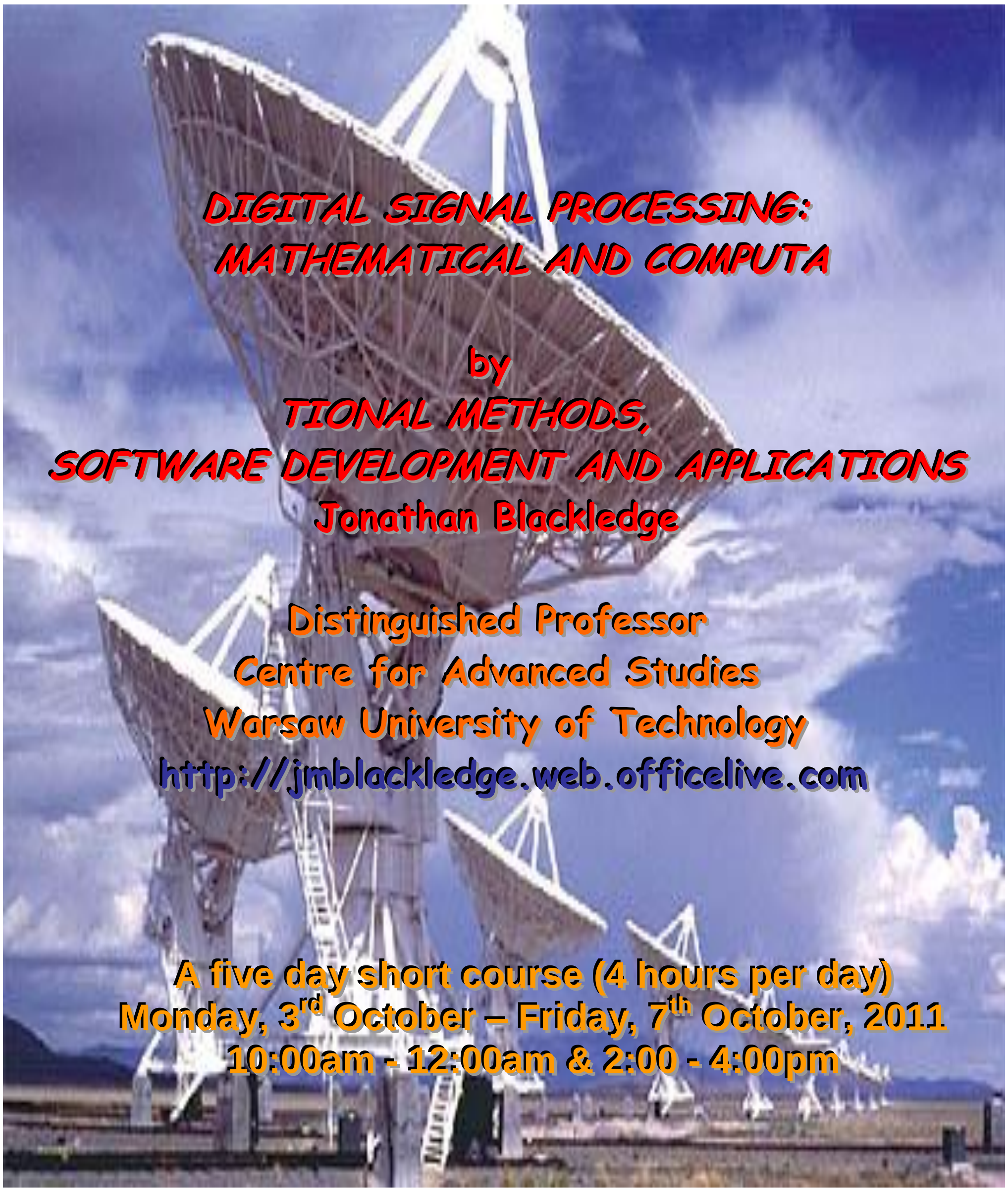
WARSAW UNIVERSITY OF TECHNOLOGY
DEVELOPMENT PROGRAMME

Centrum Studiów Zaawansowanych PW
Center for Advanced Studies WUT



ABOUT THE COURSE

This course has been designed to provide a hands-on MATLAB and C programming approach to Digital Signal Processing (DSP) and its practical implementation using MATLAB as a rapid prototyping environment. The course includes an introduction to programming in MATLAB and C focusing of those aspects of the languages that are required for the design and implementation of DSP algorithms. Emphasis is placed on the design of specific algorithms and their application to processing digital signals using a structured and procedural programming approach. This is achieved by instructing delegates on the following: (i) specifying and defining the problem in terms of an appropriate mathematical model for a signal; (ii) analysis of and solution(s) to the problem; (iii) application of appropriate numerical recipe(s); (iv) designing a suitable algorithm; (v) software implementation of the algorithm; (iv) unit testing procedures. A number of case studies are given including the applications of DSP to Radar, speech recognition, seismic imaging and

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telecommunications, for example. The course is based on the book *Digital Signal Processing (Second Edition),* J M Blackledge, Horwood Scientific Publishing, 2006 which is available from

http://eleceng.dit.ie/papers/102.pdf and involves 20 contact hours, including presentations and tutorials and will require interested delegates to complete an examination and undertake self-study assignments equivalent to 5 ECTS.

DELEGATES WILL LEARN TO

Develop numerical algorithms for DSP; write, compile and execute their own MATLAB and C functions; use their own DSP library to write applications; test their applications and investigate the results.

COURSE CONTENT

Mathematical Background	**Programming Background**
Fourier series. The Fourier transform. The Laplace and z-transforms. The Hilbert transform. Signal attributes. The Wavelet transform. Other integral transforms. The short time Fourier transform. The Gabor transform. The Wigner and Wigner-Ville transforms. The Sampling Theorem. The Orthogonality Principle. Statistical Models Random number generation and noise.	Introduction to MATLAB. Matrix and array operations. Programming in MATLAB. MATLAB Toolboxes, functions and graphics. Introduction to C. Programming structures. Operators and expressions. Arrays, Boolean expression and control. Pointers and address arithmetic. Functions. Calls and definitions. Memory management. Token and macros. Standard C libraries.
Computational Background	**Transform Domain Processing**
Computational methods in linear algebra. Direct and Iterative methods of solution. Sampling and aliasing. The Discrete Fourier Transform. The Fast Fourier Transform (FFT). Computing with the FFT. Leakage and windowing. The FIR filter. The IIR filter. Recursive filters.	Deconvolution and inverse filtering. The Wiener filter. Matched filtering and linear FM signals. Bayesian estimation methods. The Maximum Entropy method. Constrained deconvolution. Homomorphic filtering. The Kalman filter. Wavelet based processing methods. Spectral extrapolation.
Time Domain Processing	**Applications**
Non-stationary deconvolution. Singular Value Decomposition. Random signals and systems. Statistical filtering methods. Adaptive filtering methods. Nonlinear filtering methods.	Seismic signal processing. Bio-signal processing. Audio and speech signal processing. Control systems engineering. Applications in image processing. Application in astronomy.

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