



Introduction to advanced numerical methods in engineering

Lecturers: Arkadiusz Żak, Marek Krawczuk

During the course students will learn about a variety of advanced numerical techniques available and practically used for solving complex problems of various engineering branches like: civil, electrical or mechanical engineering. After a brief introduction to the problems of numerical analysis the course is going to concentrate on stationary and non-stationary phenomena analysed in current engineering, with a special attention being paid on various numerical phenomena associated with numerical investigations.

The course is planned to embrace both scientific and technical knowledge about advanced numerical techniques used in various engineering branches that will allow students to understand not only the characteristics of particular numerical techniques, but also to reveal and understand their influences on obtained numerical solutions. As a results of the course students will also gain the knowledge about the application of particular discrete modelling techniques used in engineering and learn about their drawbacks and limitations.

The course is divided into 2 consistent modules (7.5 hours each), covering 15 hours of lectures in total, and also includes a general introduction lecture to the subject of structural dynamics.

The first module, authored by Professor Krawczuk, embraces information and lectures on characteristics and analysis of selected numerical problems by:

1. General introduction to stationary and non-stationary problems (i.e. eigenvalues, eigenmodes, heat transfer, transient vibrations, wave propagation, etc.)

2. Finite Difference Method (FDM),

The second module, authored by Professor Żak, embraces information and lectures on characteristics and analysis of selected numerical problems by:

3. Finite Element Method (FEM),
4. Frequency and Time-domain Spectral Finite Element Methods (FD-SFEM, TD-SFEM),

Within the course all lectures will be given by Professor Żak.



Abstract:

By many the beginning of the new era of computers dates from the launch of the ENIAC computer (Electronic Numerical Integrator and Computer) in the USA in 1942. Since that time an incredible progress has been made in the subject of computing machines leading to the nowadays multi-core and multi-processor super computers of unbelievable computing powers. In parallel to this a new branch of numerical methods has been rapidly developing taking full advantage of the achievements and results of mathematical sciences. During that time a number of specialised numerical techniques have been developed in order to tackle very specific engineering problems. Among many of such techniques a number of them has been found as highly robust and especially useful. Among many as leading techniques the following two techniques may be considered:

1. Finite Difference Method (FDM),
2. Finite Element Method (FEM),

as well as such the most recent computation techniques including:

3. Frequency-domain Spectral Finite Element Method (FD-SFEM),
4. Time-domain Spectral Finite Element Method (TD-SFEM).

It should be understood that the application of particular modelling techniques has a direct influence on the results of numerical simulations obtained by their use. Appropriate selection of time integration schemes, node distributions, element formulations, orders of applied theories or even types of quadrature employed for space integration are here all of great importance. All these aspects should be properly addressed, uncovered and understood in order to take full advantage of the capabilities of the advanced numerical modelling techniques in the field of nowadays engineering.

Terminy wykładów			
Data	Dzień tyg.	Godzina	Sala
2015-03-02	Pn	9.00-11.00	EiA E28
2015-03-03	Wt	9.00-11.00	EiA E28
2015-03-04	Śr	9.00-11.00	EiA E28
2015-03-05	Cz	9.00-11.00	EiA E28
2015-03-06	Pt	9.00-11.00	EiA E28
2015-03-09	Pn	9.00-11.00	EiA E28
2015-03-10	Wt	8.00-11.00	EiA E28



KAPITAŁ LUDZKI
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