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DEPARTMENT OF CONCRETE STRUCTURES Lodz University of Technology Division of Geotechnics and Engineering Structures		K-61 https://docplayer.pl/50834536-Historia-i-perspektywy-rozwoju-katedry-geotechniki-i-budowli-inzynierskich-politechniki-lodzkiej.html
Director: Prof. Dr. hab. eng. Marek Lefik	Members of the team PhD. eng. Anna Hummel, PhD. eng. Jakub Jarosz, PhD. Barbara Michalska, PhD. eng. Marek Wojciechowski.	Contact person: tel: 42-631-35-92 marek.lefik@p.lodz.pl
scope of activities: Interdisciplinary research activity of the Division covers a wide range of problems related to both the scientific development of team members and current issues of geotechnics related to the development of this discipline and the application of its achievements in the economy. The common denominator of these issues is the use of numerical methods such as the Finite Element Method (FEM) and Artificial Neural Networks (ANNs) to solve the problems of geotechnics and environmental geotechnics. Team members develop the following research topics: 1. use of FEM and ANN to analyze highly heterogeneous media (homogenization); 2. application of FEM to solve classical engineering problems of geotechnics; 3. application of FEM and ANN to solve the inverse problem related to experimental research in geotechnics; 4. problems of water permeability of sands, especially hydrophobized sands; 5. modeling of issues related to the spread of pollutants in the soil. Within themes 1 and 2, a habilitation thesis is created, topic 3 is developed in two doctorates. The first one concerns the inverse analysis with the use of ANN in the interpretation of dynamic deflectometer tests of layered pavements, the second concerns the interpretation of the results of CPTU soundings with the use of ANNs of the seq2seq type. Research opportunities for the benefit of the economy include: 1. laboratory tests (triaxial apparatus and other tools) of mechanical and hydraulic properties of soils; 2. in situ soil properties testing using the CPTU static probe; 3. Data interpretation using inverse analysis methods. The team also develops issues related to road traffic engineering and public urban transport. Dr. Eng. Anna Hummel conducts classes and diplomas on issues related to this subject. Construction issues of buildings belonging to the transport infrastructure are the subject of activity of Dr. Eng. Jakub Jarosz. The "Interactive Activation and Competition" artificial neural network was used to study the river network in Łódź using the standard River Habitat Survey observation procedure. These studies are conducted by Dr. Barbara Michalska. The subject scope of research and scientific activity is a part of the Regional Specializations, which was confirmed by the inclusion of this project in the Territorial Contract for the Lodzkie Voivodship. To the greatest extent, it belongs to the specialization: Advanced Building Materials.		Static probe CPTU  Three-axial apparatus with the possibility of testing polluted soils, Row chambers
1. Reduced models in geotechnics, generalizations and determination of parameters on the basis of in situ tests and solving the inverse problem using the ANN inverse relation approximation method. 2. Application of ANN for the interpretation of in situ test results with the use of the CPTU probe and the Marchetti dilatometer. 2. Development of a authors code of the Finite Element Method for the analysis of hydro-mechanical phenomena in fragmented media (Dr. Marek Wojciechowski). 3. Application of hydrophobized sands in the construction of barriers in contaminated soils. 4. Numerical modeling of the spread of pollutants in soils.		Hydrofobized sand 
Publications/patents, awards, projects: Legal protection of the invention P-401246, Patent Pat-228194 pt. "Method for the preparation of alkoxyasilanes, a mixture		



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hydrophobizing-modifying and the method of its production ". The authorship of the invention is shared (50% each) with the team of employees of the Center for Molecular Research of the Polish Academy of Sciences in Łódź.

Keywords: soil mechanical properties, soil constitutive models, CPTU, Marchetti's dilatometer, hydrophobization, homogenization, finite element method, Artificial neural networks, machine learning, River Habitat Survey

List of internship proposals in a given research group:

Padova University, Faculty of Civil Engineering and Environment Engineering, Padua, Italy