Automatic generation of a 3D Finite Element Model for Mechanized Tunneling

The Institute for Structural Engineering of the Ruhr-Universität Bochum is offering a three-month internship through the RISE program of the DAAD. The trainee will support a research assistant at our institution in his scientific work concerning mechanized soft ground tunneling.

Scientific focus:
In current tunneling practice, Finite Element (FE) simulations have become an integral element of the planning and design process. These models are most often manually generated using 2D AutoCAD drawings, which is a laborious and time consuming process. Furthermore, most tunnel and sub-surface geometries are relatively similar, and can be reduced to and described by certain basic parameters, such as tunnel diameter, tunnel depth, tunnel alignment, and soil layer depths. Therefore an automatic model generation concept lends itself well to the creation of 3D FE models for tunnels. It is for these reasons that an automatic modeler for tunnels has recently been developed at the Institute for Structural analysis at the Ruhr University in Bochum. This modeler takes 3D geometrical Data of the subsoil and automatically generates the lining, grouting, and necessary boundary conditions that represent the excavation steps.

Tasks and Requirement Profile
The main body of work in this project will be performed using the open source Finite Element (FE) code Kratos Multiphysics in conjunction with the GiD pre- and post-processor. The Student will work on expanding an existing automatic model generator in order to improve its robustness and to increase its range of applicability. It is recommended that the student have some programming experience.

Surroundings
Bochum lies in the center of the Ruhr-Area, which, with over 5 million inhabitants, is the most populous region in Germany. Although the Ruhr-Area is a former coal-mining region, many old industrial facilities have been reimagined as exhibition spaces and tourist attractions. A diversified cultural program and a broad offer of recreational activities led to the Ruhr-region being named the European Capital of Culture 2010. Furthermore, With 15 colleges and universities, the region boasts the highest density of research institutions in Europe. The Institute for Structural Analysis at the Ruhr-University Bochum is largely focused on the development and improvement of existing Finite Element Technologies. Furthermore, the head of the institute, Prof. Dr. Günther Meschke is also the speaker for a German Research Foundation funded Collaborative Research Center 837 “Interaction Methods for mechanized Tunneling,” and, as such, the institute, as well as the University, is at the center of Tunneling research in Germany.

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