Secondment by: Dmytro Iurashev
Host: Technische Universität München
Duration: 03/11/2014-30/01/2015

As a part of my work in the TANGO Project I had to spend at least two months at one of the Project partners. I was investigating the model that solves non-linear compressible Navier-Stokes equations and transport equation of stoichiometric variable implemented in OpenFOAM. I was performing simulations in time domain. I was searching for an experimental setup on which I could verify my model. It should have been a small-scale setup with geometry configuration and operating parameters similar to Ansaldo Energia test rig. Measurements of the Flame Transfer Function (FTF) of that test rig should have been available. I have found such a test rig – BRS test rig – at one of our partners, Prof. Wolfgang Polifke at the Technische Universität München (TUM).

The main scope of my secondment was to verify the model I had so far in order to apply it afterwards to industrial gas turbines. When I started my secondment I realized that the flame in my model should respond to velocity perturbations and to the changes of the flame area. Thus, I shifted myself to the model that takes into account these two features. First, I implemented Turbulent Flame Closure (TFC) model into OpenFOAM libraries and later I have done the same with the Flame Speed Closure (FSC) model. I focused my work during my secondment at TUM on CFD calculations of flame response to velocity perturbations in open-loop system. I found the steady-state solutions of the combustion in the BRS test rig using both TFC and FSC models. The FSC model predicts slightly better agreement with experimental results than the TFC one. I performed parametric analyses of coefficients of the models and I found the optimal ones. Starting from steady-state solution, Alp Albayrak, a TANGO fellow at the TUM, launched System Identification of the numerical FTF of the BRS test rig with the FSC model that I have implemented in the OpenFOAM. We found good agreement between numerically obtained FTF and experimental one. The difference that we observed is explained by the heat losses that are present in the BRS test rig but hopefully are absent in Ansaldo Energia gas turbines. Therefore, it is possible to use the developed model in the prediction of combustion instabilities in industrial gas turbines. I am going to introduce either TFC or FSC model into the model I used before. After that, I am going to use this coupled model to investigate the entire closed-loop system.

After the end of my secondment at the TUM, I have continued the collaboration with Alp in order to complete the started work with further analyses. The paper “Turbulent Flame Models for Prediction of Pressure Oscillations in Gas Turbine Burners” in the Proceedings of the 22nd International Congress on Sound and Vibration is the result of my secondment to the TUM.

Apart from technical aspects, I found an apartment in Munich with the help of the service that proposes apartments for short stay. It was situated very close to the subway, so it was very comfortable to get to the University. I was warmly welcomed by TANGO participants at the TUM and not only by them. We were visiting the university canteen together with other students of the department. I was invited to social events of the department such as excursion to experimental setups at the department and the Christmas eve.

Additionally, I had the possibility to visit Munich and its surroundings, which are full of museums and interesting places to visit. I have been there in right time to visit Christmas markets in the centre of the city. Also I have visited some of the numerous museums, parks, the zoo and the amazing Neuschwanstein castle.