ANNEX A

PUBLIC SELECTION BASED ON QUALIFICATIONS AND INTERVIEW FOR THE AWARDING OF NO. 2 EXPERIENCED GRANTS FOR CONDUCTING RESEARCH PURSUANT TO ART. 22 OF LAW NO. 240/2010 AT THE UNIVERSITY OF BERGAMO ON THE "*GO FOR IT*" PROJECT PROMOTED BY FONDAZIONE CRUI – PICA CODE 20AR031

announced with decree of the Chancellor Rep. no. 626/2020 of 07.12.2020 and posted on the official registry of the University on 11.12.2020

RESEARCH PROJECT – CODE N. 1

"Experimental investigation of atomisation in high-speed atomisers"

Research structure: Department of Engineering and Applied Sciences

Duration of the grant: 12 months

Scientific Area: 09 – Industrial and information engineering

Academic recruitment field: 09/C2 - Thermal sciences, energy technology, building physics and nuclear engineering

Academic discipline: ING-IND/10 - Thermal engineering and industrial energy systems

Scientific Director: Prof. Gianpietro Cossali

The research topic is the study of the atomisation mechanisms due to the interaction of a liquid jet with a high velocity (sonic) gas jet. The understanding of the dominant physical mechanisms that drive the interaction between the two jets is considered crucial for an improvement of the atomisation efficiency, with the particular aim of reducing the gas mass flow rate and its pressure.
The research activity that will be funded is the experimental study of a high velocity (sonic) nebulizer provided by PARI Gmbh. The nebuliser has the function of yielding liquid drops of very small size (some microns), capable to follow the inhaled air flow to allow the active substances contained in the liquid to reach the lungs. The liquid atomisation is obtained from the interaction of a liquid jet with a high speed gas jet, which break-up the liquid stream into ligaments and yields their impact on a small solid surface to complete the nebulisation.
This activity is part of a running research project (DROPIT) where the study of the high speed atomisation is carried on mainly by a numerical approach. ITLR (Institut für Thermodynamik der Luft- und Raumfahrt) in Stuttgart University has developed a CFD code (FS3D: Free Surface 3D) that has been used at ITLR for more than 20 years and is constantly being further developed. Direct numerical simulation (DNS) is used to solve the incompressible Navier-Stokes equations, so no turbulence models are needed, and the Volume-of-Fluid (VOF) method is used to describe multiphase flow. To deal with the high computational effort involved, FS3D is parallelized using the MPI libraries and OpenMP, so that even complex problems can be investigated and it run on the supercomputer Cray XC40, available at HLRS (Performance Computing Center Stuttgart), which is one of the most powerful HPC systems in the world. Given the high complexity of the atomisation phenomena the validation of the numerical predictions need the comparison with experimental results, and it is in this context that this activity fits.
The post-doc researcher will have access to ITLR laboratories and he/she will make use of shadowgraphic techniques for the visualisation of the phenomenon and of Phase Doppler Anemometry (PDA) for the quantitative measurements of drop size and velocity.

RESEARCH PROJECT – CODE N. 2

"Machine Learning Approach for Social Sciences"

Research structure: Department of Economics
Duration of the grant: 12 months
Scientific Area: 13 – Economics and statistics
Academic recruitment field: 13/A2 – Economic policy
Academic discipline: SECS-P/02 – Economic policy
Scientific Director: Dott. Sergio GALLETTA

This project has the main objective of investigating how machine learning (ML) techniques can improve the conventional empirical approach applied by social scientists. While there is a growing number of researchers in economics, political science, and sociology that use tools that are standard to computer scientists, there is not yet a clear understanding of what are the areas of research that could benefit from this methodological revolution. This is partially due to the inherited conceptual difference between ML and empirical social science. Indeed, while ML approaches are typically used to predict the value of specific outcomes based on a set of observables features, applied social scientists usually have a different objective, identifying causal effects. Within this project's scope, we will emphasize the main contribution that ML can provide to empirical social scientists. In particular, we will exploit the incredible opportunity created by ML tools to provide new measures (variables) related to human activities/behaviors/sentiment, which are often hidden in the interactions of multiple variables.
The research activity comprises different tasks. Initially, the grant holder will be required to identify a set of data sources to exemplify the potential use of ML with social science data. For instance, standard sources are political speeches, media contents, social media interaction, or survey data. Once these sources are recognized, it will start the acquisition task. Next, the grant holder will be involved in the actual exploration of how the acquired data could be analyzed using ML approaches. We expect the grant holder to test the reliability of novel Natural Language Processing (NLP) methodologies to decoding text into data. Similarly, unsupervised machine learning models, such as Latent Dirichlet Allocation (LDA), will be tested as a method to enhance a better understanding of individual-level data from survey responses. The final step of the project is to select a series of existing causal applications and observe how the results might be affected by the use of ML generated outcome variables.
Finally, it is worth stressing that the different tasks are supposed to be completed while the grant holder will be visiting the foreign partner institution (ETH Zurich - Law, Economics and Data Science group). This research is mainly funded by the Fondazione CRUI "Go for IT" project.