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Supervisor Expression of Interest
MSCA-IF Marie Sklodowska Curie Action-Individual Fellowship 2019

Supervisor name:	Aberto Guardone
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Department Name: Research topic:	Department of Aerospace Science and Technology Research topic: Aviation and the Environment, PE3_14 Fluid dynamics
MSCA-IF Research Area Panels	☐ CHE_Chemistry ☐ ECO_Economic Sciences X ENG_Information Science and Engineering ☐ ENV_Environmental and Geosciences ☐ LIF_Life Sciences ☐ MAT_Mathematics ☐ PHY_Physics ☐ SOC_Social Sciences and Humanities
Politecnico di Milano Areas:	☐ Cultural Heritage X Smart Cities ☐ Territorial Fragilities ☐ Health ☐ Industry 4.0
Brief description of the Department and Research Group (including URL if applicable):	The interdipartimental laboratory CREALab is investigating fluid mechanics for operating conditions near the Thermodynamic Critical Point (TCP) of liquid-vapour phase transition in complex fluids. This systematic study is required for the design of Organic Rankine Cycles power systems for low temperature energy sources, whereby the thermodynamic conditions are far from the dilute-gas limit. A unique test rig (the Test Rig for Organic VApors) has been designed in the CREALab in order to experimentally characterise the near-TCP non-classical gasdynamics in ORC applications (e.g. expansion shockwaves). An effort is also conducted on the improvement of the capabilities of CFD solvers to accurately capture these flow conditions. The group is currently benefiting from an ERC funding (ERC Consolidator Grant 617603). Supervisor web page: aero.polimi.it/Guardone Laboratory web page: https://crealab.polimi.it/

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Brief project description: **(max 1 page)**	Multi-phase flows involving liquid droplets moving within a gaseous media are of interest to diverse industrial applications, including ice accretion over civil and aeronautical structure, Rakine cycle power systems and ink-jet printers, to name a few. The accurate prediction of the droplet trajectories and of thermodynamic changes occurring within the liquid droplet due to interaction with the flow field, with other droplets or with the boundaries, calls for further investigation into the modelling and the numerical simulation of such flows. The proposed research project focus on the numerical simulation of droplet one-way dynamics within a gaseous flow, and it moves from current in-house capabilities in connection with the numerical simulation of ice accretion over fixed- and rotary- wing aircraft. The PoliDrop and PoliMIce toolkits use a Lagrangian particle tracking scheme to compute the droplet trajectory from the cloud up to the impingement point on the aircraft. The MSCN researcher will actively contribute to the further development of the PoliDrop code to include thermodynamic disequilibrium features, namely, condensation and evaporation, and accurate solidification models upon impact on the surface. The numerical tool will be applied to the simulation of the evaporation process of two-phase flows of pure organic fluids, which are commonly used in ORC applications. The envisaged approach combines the physically sound Lagrangian description of the drop dynamics to the more efficient, empirical Eulerian one. In fact, a two-way calibration procedure for the disequilibrium Eulerian solver is foreseen to improve the accuracy of the sub-grid Eulerian terms accounting for local mass, momentum and energy disequilibrium. The numerical models will be validated against experimental data available in the open literature. Ad hoc experimental trials will be carried out at the CREA laboratory to support the derivation of the thermodynamic models.