

Development of adjoint methods for isothermal cavitating flows for optimising hydro-turbines (MFLOPS-DC1)

MARIE CURIE GRANT / AGREEMENT NUMBER / 101072851

The Doctoral Candidate (DC1) will be hired for 36 months as part of the *Multiphase Flow Optimisation Strategies (MFLOPS)* project being funded through the Horizon Europe Marie Skłodowska-Curie Actions (MSCA) Doctoral Networks. DC1 will be enrolled in the PhD program of the School of Mechanical Engineering of the National Technical University of Athens (NTUA), Greece. The DC1 individual project will be realized at the NTUA (into the Parallel CFD & Optimization Unit or PCOpt, headed by Prof. K. Giannakoglou). Main activities of the PCOpt/NTUA Unit are the development of CFD and optimisation methods and tools in the general field of fluid mechanics, in the field of turbomachines etc (see <http://147.102.55.162/research/> for more details). A 4-month secondment (within the 36-month period) at ANDRITZ HYDRO GmbH (AHS-AT), at Linz, Austria is scheduled, after the 18th month of the project.

The first objective of DC1 is to expand the in-house GPU-enabled CFD PUMA flow solver (programmed in C++/CUDA and running on the PCOpt/NTUA cluster of NVIDIA GPUs) by including cavitation models to be assessed using experimental data from the literature or provided by the collaborating industry. The second objective of DC1 is the mathematical formulation of the continuous adjoint method for objective functions related to cavitation control/suppression, programming in PUMA and verification of the gradients computed by the adjoint method against finite differences. Finally, DC1 will adapt the in-house geometrical modeler GMTurbo, originally supporting only gas turbine bladings, to blade rows of hydraulic turbomachines before finally applying the developed optimisation tool to full-scale hydraulic turbines provided by AHS-AT.

ADDITIONAL INFORMATION

Benefits

The selected candidate will receive a salary in accordance with the MSCA regulations for DCs. The gross salary includes a living allowance (€2774.40 per month), a mobility allowance (€600 per month) and a family allowance (€660 per month), if the researcher has family ('Family' means persons linked to the researcher by (i) marriage or (ii) a relationship with equivalent status to a marriage recognized by the legislation of the country where this relationship was formalized or (iii) dependent children who are actually being maintained by the researcher). The guaranteed (EC) funding is for 36 months.

Eligibility criteria

Applicants can be of any nationality and must hold a Master of Science degree (or equivalent) in engineering. They need to fully respect the following eligibility criteria:

- (a) Must be doctoral candidates, i.e. not already in possession of a doctoral degree at the date of the recruitment
- (b) Must undertake transnational mobility. Researchers must not have resided or carried out their main activity (work, studies, etc.) in Greece for more than 12 months within the 36 months immediately before their date of recruitment. Compulsory national service, short

stays such as holidays, and time spent as part of a procedure for obtaining refugee status under the Geneva Convention are not taken into account.

Other Information

DC1 will be working (excluding the secondment) at the Zografou Campus of NTUA in Athens, Greece. The PCOpt/NTUA group consists of about 15 people, including 4 experienced researchers, among which the major developers of the PUMA and its adjoint code. Apart from the PhD thesis supervisor (Prof. K. Giannakoglou), researchers of the PCOpt/NTUA Unit with previous experience in similar tasks (CFD code running on GPUs, adjoint methods, shape parameterization, cavitation models) will support DC1 in her/his project/PhD. The PCOpt/NTUA Unit possesses a powerful multiprocessor platform, including both CPU and GPU clusters, which is expected to be upgraded during the project life; this will support research to be performed by the DC1.

REQUIREMENTS

Required Educational Level

Engineering: Master Degree or equivalent

Skills/Qualifications

Candidates should have a strong background in CFD. In order of importance, they should possess good programming skills in C++ (mandatory) and CUDA-C (i.e. the programming environment in which PUMA has been developed in) and experience in using high-performance computing centers (HPC). Some background on hydraulic turbines and experience in using/developing adjoint-based optimization methods are welcome. This position is in the field of CFD for incompressible/cavitating flows, in rotating machines, not based on commercial CFD s/w. Though experience from using commercial CFD s/w is welcome and surely helps, this position requires good programming skills and is addressed to programmers, rather than just users, of CFD s/w. Excellent knowledge of written and spoken English (working language) is required.

DEADLINES - APPLICATIONS

Applications should be received by **30 April 2023, at 20:00 CET**, at the latest.

The candidates should send a CV, cover letter (in which the applicant's experience in CFD development should become clear), BSc and MSc degrees (certified copies plus translation in English), and two letters of recommendation are necessary. Copies of publications could be sent later on, upon request. Personal interviews might be asked.

All applications should be mailed to kgianna@mail.ntua.gr (email subject: "MFLOPS-DC1-Application").

The outcome of the evaluation process will be announced by mid of May 2023. The three-year contract is expected to start in the period May 2023-September 2023.