Deutsches Zentrum für Luft- und Raumfahrt
German Aerospace Center

DAAD Deutscher Akademischer Austauschdienst
German Academic Exchange Service

Linder Höhe
D-51147 Köln
Telephone: +49 (0)2203 601-0
Internet: https://www.dlr.de

Kennedyallee 50
D-53175 Bonn
Telephone: +49 (0)228 882-0
E-mail: dlr-daad-program@daad.de
Internet: https://www.daad.de/dlr

DLR – DAAD Fellowships

Fellowship No. 522

Research Area : Aeronautics

Research Topic: **Focused Laser Differential Interferometry (FLDI) for Hypersonic Application in the High Enthalpy Shock Tunnel Göttingen (HEG)**

DLR Institute: German Aerospace Center
Institute of Aerodynamics and Flow Technology
Aerospace Department
DLR Göttingen

Position: Postdoctoral Fellow

Openings: 1

Job Specification: The High Enthalpy Shock Tunnel Göttingen (HEG) is a free piston driven shock tunnel commissioned for use in 1991. It is extensively used in a large number of national and international space and hypersonic flight activities and thus is one of the major hypersonic laboratories in Europe. The research activities at HEG are strongly linked to computational fluid dynamics as well as the development of measurement techniques. The scope of the studies covers for instance generic aerodynamic configurations, fundamental aspects of high enthalpy flows, complex hypersonic flight configurations, integrated scramjet configurations and hypersonic boundary layer transition and transition control strategies.

The technique of Focused Laser Differential Interferometry (FLDI) was recently successfully applied to hypersonic flows at HEG in order to investigate high frequency boundary layer instabilities as well as shock boundary layer interactions in fully turbulent hypersonic flows. FLDI is an optical technique for the detection of density fluctuations in transparent media. It has gained attention in the hypersonic research community in the recent years, due to its remarkably high bandwidth and its ability to reject high-frequency noise away from the foci. It is therefore a powerful tool to probe the smallest scales of flow field structures, relevant to boundary layer transition and turbulence investigations. Further interest stems from the possibility of velocity measurements, upon the duplication of an FLDI system. A shortcoming of the FLDI technique is that it provides measurements in a very localised region of the flow field only. This requires multiple shock tunnel runs to provide a comprehensive overview of the investigated fluid dynamics. This problem is partially overcome by sequentially repeating the system. However, increasing complexity and limited power efficiency prevents a large number of probes to be obtained in this way.

The FLDI setup currently operational in HEG is composed of four independent probes, stemming from two sequential beam duplications. The successful applicant will advance the existing system by implementing new methods to drastically improve the capabilities of simultaneously probing at multiple locations in the flow field. Two approaches are currently state-of-the art of multi-foci FLDI systems. One approach uses conical lenses to produce FLDI foci that are stretched along a direction perpendicular to the optical axis providing probing locations for multiple detectors. An alternative approach, is based on a custom-made diffractive optical element splitting the incoming beam on the emitting side into multiple discrete components. This creates several separate FLDI foci aligned with separate detectors on the receiving side.

Required Qualification: phd in Aerospace Engineering or related fields

Advantageous Skills: background in experimental hypersonic testing,
experience in applied optics

English competence: See requirements on www.daad.de/dlr

Earliest Start Date: 01.04.2022

Application Deadline: **31.03.2022**

Further Information: http://www.dlr.de
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