ESCUELA POLITÉCNICA NACIONAL

CONVOCATORIA PARA LA SEGUNDA COHORTE DEL PROGRAMA DE DOCTORADO EN CIENCIAS DE LA MECÁNICA

El programa de doctorado en Ciencias de la Mecánica de la Escuela Politécnica Nacional ha abierto su segunda cohorte. Se invita a las personas interesadas en postular a presentar la documentación en la secretaría del programa hasta el día 15 de diciembre de 2017. Más información acerca del programa, contactarse con la secretaria del programa (nancy.torres@epn.edu.ec), o más información de los temas propuestos directamente con el profesor proponente.

El programa de doctorado en Ciencias de la Mecánica es un programa multidisciplinario que cubre las áreas de Energía, Materiales y Diseño de Máquinas. Las investigaciones que se llevan a cabo son de carácter fundamental, numérico y experimental con el fin de responder a las necesidades de desarrollo del país y del mundo: generación de energía, desarrollo de materiales, diseño de maquinaria, conservación del medio ambiente. El programa busca formar sólidamente a investigadores con capacidad de entender, formular y resolver los problemas actuales de la sociedad.

Requisitos de postulación:

- Copia del título de grado y de maestría previamente registrados en el SENESCYT.
- Hoja de vida en el formato EPN
- Certificado de idioma inglés (nivel mínimo B2)
- Carta de motivación
- Solicitud de inscripción al programa doctoral dirigida al Comité Doctoral
- Carta de un profesor del programa que auspicia su entrada al programa
- Documento que certifique la dedicación a tiempo completo al programa (declaración juramentada, carta de la entidad en que labora, etc.)

PROYECTOS PROPUESTOS PARA LA SEGUNDA COHORTE DEL PROGRAMA EN CIENCIAS DE LA MECÁNICA

NAME

Distributed propulsion systems for aerial platforms

ABSTRACT

The growing pollution and scarcity of resources for sustainable development encourage the searching of novel propulsion architectures, which enable to achieve ambitious performance targets such as NASA N+3 and ACARE 2020. In this context, this work focuses on the study of novel propulsion architectures for aerial manned/unmanned platforms of short range. Some of the technologies that will be examined are: Distributed propulsion, Innovative thermodynamic cycles, Gas turbines, Fuel cells. For this aim is required the development of a methodology that encompasses different aspects of design and accounts for aerodynamic integration effects in highly coupled configurations such as: embedded/semi-embedded propulsor. This work also has an experimental part which will assess aerodynamically the optimal concepts and will use the facilities of the LMFT (Tubomachinery laboratory) to this aim.

Keywords: Distributed propulsion, Innovative thermodynamic cycles, Gas turbines, Fuel cells

REQUIRED PROFILE

- M.Sc. in Aerospace Engineering, Mechanical Engineering or a directly related field
- Good English level (at least B2)
- Some programming experience (Javascript, C++, C#, Python, Matlab)
- Some experience with CFD simulation (ANSYS, OpenFoam)
- Some experience working with Linux and Open source software
- Ability to work with a multidisciplinary, international, regionally dispersed research team and carry out tasks autonomously

CONTACT

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PROYECTOS PROPUESTOS PARA LA SEGUNDA COHORTE DEL PROGRAMA EN CIENCIAS DE LA MECÁNICA

NAME

Development of a medium temperature solar receiver by using nanofluids

ABSTRACT

The receiver is a key component in any energy solar system. It is responsible in a high degree of the efficiency of such systems. An alternative to rise the receiver efficiency is to use volumetric receivers instead surface receivers. This kind of receivers has some advantages such as the increment of the optical efficiency and the decrease of the absorber temperature (in comparison with a surface receiver). As consequence, the thermal efficiency increases and there are less thermo-mechanical issues in the absorber. Volumetric receivers have been used for high, medium and low temperature. Nanofluids may significantly increase thermal and optic properties of the base fluid. In this field the largest effort has been made for low temperature receivers. Therefore, more researches are necessaries to depth in the knowledge of the working ranges of the parameters that drive the optical and thermal behavior of a medium temperature receiver that uses nanofluids as absorber. This project proposes to investigate, experimental and numerically, the thermal behavior of a medium temperature solar receiver using nanofluids as absorber. The nanofluid will be confined in a transparent pipe. For the numerical approach, the radiative behavior of the solar absorption will be developed. Two ways are taken into account: Monte Carlo approach and Discrete Ordinates approach. Second, the radiative model will be coupled with a thermal model for the proposed geometry. Fortran, Matlab and Fluent will be used. For the experimental approach, the conception of a concentrated solar testing bank will be made. At the same time, some nanoparticles will be synthetized. Nanofluids with different concentrations and leans will be made. The thermal and optical characterization of such nanofluids will be done. Then, some experiments will be conducted in order to validate the developed models. Once the models will be validated, parametric studies and optimizations will be done in order to maximize the thermal efficiency of the receiver. To achieve the objectives, the infrastructure, the equipment and the knowledge of New Materials Laboratory and Heat Transfer Laboratory of the Mechanical Engineering Faculty of the National Polytechnic School will be disposed. The access to the ModeMat cluster (3 HP C7000 and 30 blades) is also available. Additionally, the New Materials Laboratory has the necessary equipment to synthetize and to characterize different kinds of nanoparticles.

Keywords: Nanofluids, Volumetric solar receiver, Modelling and optimization, Monte Carlo

REQUIRED PROFILE

- M.Sc. in Thermal Sciences, Mechanical Engineering or a directly related field
- Good English level (at least B2)
- Some programming experience (Fortran, Matlab)
- Some experience with CFD simulation (ANSYS, OpenFoam)
- Ability to work with a multidisciplinary, international, regionally dispersed research team and carry out tasks autonomously

CONTACT

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NAME

Improving numerical wave forecasting in the Equatorial Pacific Ocean.

ABSTRACT

Accurate wave data is fundamental for several applications like climate and climate change studies, coastal planning, design of coastal and offshore structures, renewable and non-renewable energy resources, among many others. Numerical Wave Prediction in the Eastern Equatorial Pacific (EEP) involves several challenges related to the presence of swells arriving from both hemispheres. Model verification and evaluation is carried out with Satellite observations from the EnviSat mission (European Space Agency), plus in-situ measurements from the Galapagos Islands, and three Colombian moorings from DIMAR (Dirección General Marítima de Colombia). Results show that current model formulations for swell dissipation and white-capping breaking are still not able to properly represent the wave spectral distribution. Because of the mesoscale character of the physical processes at work, the causes can be found in both meteorological and wave phenomena. For instance, a deficient representation of wind fields in any area of the vast Pacific has influence in the results at the EEP. Moreover, wave model deficiencies related to energy advection, dissipation or wave-wave interactions, are expected to play a major role. In this study, we propose different strategies for improving wave prediction. From a physical point of view, we consider a through evaluation and identification of the sources, including a reformulation of the present physical representations. Numerical approaches involve the implementation of data assimilation and optimization procedures. Our current forecast setup is based on the WaveWatchIII model from the NOAA (National Ocean and Atmospheric Administration, USA), and the coastal model SWAN (Simulating Waves Nearshore) for downscalling.

Keywords: wave spectrum, wave modelling, Eastern Equatorial Pacific, WaveWatchIII, SWAN, EnviSat.

REQUIRED PROFILE

- M.Sc. in mechanical, civil, or environmental engineering, physics, or mathematics.
- Good English level (at least B2).
- Good programming skills (Shell, Matlab, Fortran, C++, Python, Pearl).
- Ability to work independently and within a multidisciplinary, international team.

CONTACT

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NAME

Spectral wave data assimilation scheme for operational forecasting

ABSTRACT

There are several challenges in wave spectral data assimilation (DA). The first is related to the fundamental structure of the variable to deal with, which is a 2D matrix containing the wave energy distribution in frequency and direction. This distribution is characterized by the existence of energy clusters associated to different meteorological genesis, i.e., wave systems. Consistent wave DA must consider these individual wave systems separately because in bi-modal or multi-modal sea states integral parameters of the whole spectrum lose significantly their meaning. Another challenge is associated to the inherent variability contained in data in general and spectral wave data in particular. The uncertainties associated to the directional distribution of measured spectra are large, if at all known. In general also, a one to one match between model and observed wave systems is unlikely so a robust cross-assignment algorithm is a fundamental component of the whole system. Moreover, DA in general consists of spreading point measured information into the model spatial domain. In any particular area every overlapping wave system has its own spatial domain plus other specific characteristics, which need to be characterized in order to determine the associated background errors, the other fundamental element of the DA system. From the model point of view the dissection and the later recomposition of its main variable, the wave spectrum, is a promise of numerical instabilities. For most of these challenges a sound technique is the use of spectral partitioning and long-term wave spectral statistics, which allows characterizing wave systems, carry out a consistent cross-assignment between observations and model systems, and specifying background errors. For the optimization step, several strategies need to be tested (e.g., Optimal Interpolation, 3DVAR, 4DVAR) and assessed in terms of effectiveness and efficiency. The modelling platform is the WaveWatch III model, and the data to be used are any type of spectral wave data, including directional buoys or satellite SAR spectra.

Keywords: wave data assimilation, wave spectrum, spectral partitioning, wave spectral statistics, wave modelling, background errors, Optimal Interpolation, 3DVAR, 4DVAR, WaveWatchIII.

REQUIRED PROFILE

- M.Sc. in mechanical, civil, environmental engineering, physics, mathematics, oceanography, meteorology.
- English proficiency.
- Good programming skills (Shell, Matlab, Fortran, C++, Python, Pearl).
- Ability to work independently and within a multidisciplinary, international team.

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