UNIVERSIDAD
POLITÉCNICA
DE MADRID

APÉNDICE 1:

LINEAS DE INVESTIGACION

Laboratorio de dispositivos semiconductores avanzados

Página web: https://www.mtl.mit.edu

Palabras clave. Las palabras claves que definen las áreas en las que se puede desarrollar el trabajo son: microelectrónica, nanotecnología, dispositivos semiconductores avanzados, nuevos dispositivos para inteligencia artificial, dispositivos ferroeléctricos.

Perfiles en City Science and Engineering

Los perfiles que se buscan son diversos para trabajar en un entorno anti-disciplinar: Arquitectos, Ingenieros, Informáticos, etc. Las líneas de trabajo son:

- **CityScope**: Estudio del impacto de las dinámicas de los seres humanos en las ciudades (a través del uso de en big data, Machine Learning, AI, etc.), para el diseño de entornos urbanos más sostenibles y humanos donde la gente pueda vivir y trabajar en una distancia caminable consumiendo y produciendo productos y energía de forma local. Task: Construcción de módulos de simulación para el análisis del impacto de diferentes diseños urbanos (Software, ABM, AI, Simulation...).

- **Micro-Mobility:** Diseño de sistemas de micro-movilidad eléctrica, autónoma compartida, que permitan eliminar los coches de los centros urbanos y fomentar el uso del transporte público, y espacios públicos urbanos de escala más humana. Tasks: Construcción de vehículos robóticos autónomos (Hardware and software, AI...), Diseño de Espacios Urbanos, Simulación de Nuevos modos de movilidad (Software, ABM, AI, Simulation...).

- **Changing-Places**: Arquitectura robótica, sensorizada, y transformable que cuida de los seres humanos, y genera espacios más eficientes que permiten traer diversidad a centros urbanos donde el valor del suelo es muy elevado. Tasks: Construcción de sensores ambientales, actuadores robóticos, y trabajo de análisis de datos (Hardware and software, AI...)

Perfiles en MFE Integrated Modeling Group in the MIT Plasma Science and Fusion Center

Project: Enhancement of predictive capabilities of core transport in magnetic-confinement fusion devices

Investigator(s):
Pablo Rodriguez-Fernandez (main mentor), Nathan Howard, Audrey Saltzman

Laboratory:
MFE Integrated Modeling Group (https://mfeim.mit.edu/) at the MIT Plasma Science and Fusion Center (https://www.psfc.mit.edu/)

Project duration: 4-6 months (to be discussed with mentee), to start first week of September 2024.

Brief description:
The tokamak is poised to be the fusion device concept to deliver the first Watts of electricity from fusion reactions to the world in the upcoming decades. In order to ensure the success of fusion as an energy source and design and build fusion devices that are economically attractive, simulations of plasma dynamics ¬¬ —and particularly of the transport of energy, momentum and particles from the extremely hot core (~200.000.000 °C) to the colder edge— must be performed with high physics fidelity.
Our group at the MIT Plasma Science and Fusion Center (https://mfeim.mit.edu/) specializes in high-fidelity transport modeling, utilizing some of the most advanced simulation techniques and high-performance computing practices. We also work on creating and validating models that are capable of running much faster but that retain all the relevant physics, either from the perspective of data-driven modeling (machine learning surrogates) or reduced-physics modeling. We perform careful validation of these models against current experiments around the world and collaborate with numerous theoretical and experimental teams in cutting-edge fusion facilities.
The visiting student will work with us on computational plasma physics, tokamak data analysis and machine learning techniques. They will get involved on a variety of projects of interest to the group and the mission of the lab. The student will get familiar with tokamak core transport physics and will contribute directly to the improvement of the PORTALS framework and/or the general predictive capabilities of current transport modeling frameworks. Work will be mostly of computational nature, although data analysis of experiments might be pursued to validate and refine the physics models.
Student and mentors will meet on a weekly basis and the student will produce a final report. Successful completion of this work will likely result in co-authorship on upcoming papers on fusion reactor modeling, and, if the work is deemed exceptional, the attendance to an international conference in the relevant area to present the work in the form of a contributed poster or talk.

Qualifications:
Required: Experience with Python programming and standard computing practices. Reasonable knowledge of physics, fluid-mechanics, thermodynamics, or similar technical areas. Motivation to work on a fast-paced, impactful group of young researchers and fellow students.

Desired/Valuable: Knowledge of plasma physics and fusion energy. Experience with machine learning and object-oriented programing.Required: Experience with Python programming

Perfiles en The Integrative neuromoritiring and Critical Care Informatics Group.

Laboratory:
Website: https://incci.mit.edu/

Project duration: 3-4 months (to be discussed with mentee)

Brief description:
Research projects in the following areas: Noninvasive Continuous Estimation of Intracranial Pressure, Brain Injury in the Preterm Neonate, Early Sepsis Detection in the Emergency Department to match student interests and current group activities.

Perfiles en Energy Transition Research Group

Laboratory:
Website: MIT Energy Initiative: energy.mit.edu (group-specific website under construction)

Project duration: 6 months (to be discussed with mentee)

Our research centers on developing and utilizing large-scale models of electricity grids and multi-sector energy systems. These are used in optimization and agent-based frameworks to analyze and design future energy technologies, policies and market designs.

Depending on their interests and skills, visiting students could engage in the development of these models or applying them to a contemporary question. Our current model development work focuses on creating new decomposition and model reduction methods to allow for larger models and finding novel means to approximate non-linear details in linear models. Our current applied work is looking at the impact of low-emission aviation fuels on the hydrogen economy, flexible CCS usage, industrial decarbonization using thermal storage, and other topics. We are open to students suggesting their own applied topic.

Profile at The Harvard Biodesign Lab

Laboratory:

Website: https://biodesign.seas.harvard.edu/

Project duration: 6 month minimum (to be discussed with mentee)

Brief description:

The Harvard Biodesign Lab brings together researchers from the engineering, industrial design, medical, and business communities to develop robots and smart medical devices that are specifically intended for interacting and cooperating with humans. Our work is accomplished through new approaches to design and fabrication of actuation and sensing components (e.g. using soft materials) in addition to the development of appropriate control strategies for systems that integrate these components. These technologies are inspired by the results of experiments in human biomechanics and their development is influenced by time spent in the operating room to understand the unmet needs from clinicians. Current research projects focus on wearable robotics to assist disabled and able-bodied people, as well as wearable sensors and machine learning for estimating human movement with minimal number of sensors.