**Looking for PhD students at the University of Nevada, Reno in the United States**

We are looking for potential PhD students for enrollment in the Spring 2020 semester. Several positions may be immediately available on different projects for which descriptions can be found below. The positions include tuition and a competitive salary. The successful applicant should have a strong background in Mechanical Vibrations, Dynamical Systems, and/or Applied Mathematics. For more information regarding our research, please visit [Dr. Aureli's research page](https://wolfweb.unr.edu/~maureli/).

Potential candidates are encouraged to send a copy of their resume and transcripts to Burak Gulsacan ([bgulsacan@nevada.unr.edu](mailto:bgulsacan@nevada.unr.edu)).

***Admission Requirements:***

TOEFL/IELTS: 80/6.5

GRE: 300 (163 on Quantitive Part of the Exam)

CGPA: 3.25

***Project Descriptions:***

**Project 1: Collaborative Research: Microengineered electroactive polymer strain sensors towards soft self-powered wearable cyber-physical systems**

Recent research efforts have emphasized the vital role of soft strain sensors in a variety of applications in bioengineering, rehabilitation and medicine, soft robotics, and human-machine interactions. Current soft strain sensors often necessitate external power for operation that severely limits the possibility to make such sensors light weight, comfortable to wear, and capable of functioning over long periods of time. On the other hand, existing self-powered sensors, such as piezoelectric ceramics, are typically very stiff, non-stretchable, and limited to extremely small deformations. Thus, there exists a clear and urgent need to identify novel sensing systems that combine self-powered behavior with soft mechanical characteristics. This research will result in the development of the next generation of soft, self-powered, high sensitivity polymer-based strain sensors for applications in novel biomedical and soft robotics endeavors. When successfully deployed, these sensors could be embedded in smart gloves for use in hand rehabilitation by patients suffering from stroke or Parkinson's disease, as well as an instrumentation suite for prosthetic devices or in human-machine interfaces, or could be embedded in wearable adhesive patches and interfaced with smartphones and the internet for continuous remote personal health monitoring of vital signs. Furthermore, this project will lead to discover novel electroactive materials systems, promote advancements in advanced manufacturing and mechatronics, and benefit the multiphysics modeling community. This research will support and impact the education of graduate and undergraduate students, contributing to the formation of the next generation of researchers, engineers, and educators. Active involvement of underrepresented students will be pursued via educational and outreach activities.

This project aims at establishing a new class of electroactive materials with superior multiphysics properties towards soft, self-powered, high sensitivity strain sensor applications in cyber-physical systems. Ionic polymer metal composites are electroactive soft composite materials that comprise a thin electrically charged polymer membrane, plated with noble metal electrodes, and infused with a charged solution. Due to their combined self-powered sensor behavior and soft mechanical characteristics, ionic polymer metal composites emerge as an ideal candidate for soft strain sensor applications. However, inconsistent and uncontrollable morphology of their polymer-metal interfaces poses the challenges of limited sensitivity, poor property control, and non-versatile mode of operation. So far, these challenges have limited the use of these materials in critical engineering applications. It is hypothesized that the multiphysics sensing properties of ionic polymer metal composites can be dramatically enhanced by tailored 3D-structured microengineered polymer-metal interfaces. To test this hypothesis, this research will develop a novel fabrication process integrating electroless chemical reduction with inkjet printing to prepare ionic polymer metal composites with microengineered interfaces. These interfaces are responsible for inhomogeneous strain developed in response to a mechanical stimulus and its subsequent electrochemical transduction and sensing performance. The main goal of this research is to gain a comprehensive understanding of the structure-property relationships in microengineered ionic polymer metal composites that determine enhanced strain sensing performance. This goal will be achieved by integrating theoretical multiphysics modeling and experimental efforts and by synergizing the investigators' complementary expertise in modeling of smart materials and systems, advanced manufacturing, sensing systems, and mechatronics and controls. This project will elucidate the role of polymer-electrode interfaces in shaping the chemoelectromechanical response of the system and formalize experimentally validated models that incorporate interface morphology information to predict multiphysics sensing properties. The potential of the proposed sensing system will be demonstrated by designing, manufacturing, and testing functional sensors in experimental platforms for studies on soft robotics and human-machine interaction. The knowledge gained through this project will significantly advance the state of understanding of electroactive materials towards development of high performance sensing systems.

**Project 2: CAREER: Fluid-Structure-Control Interactions in Bioinspired Robots with Actively Morphing Fins**

This Faculty Early Career Development Program (CAREER) project will benefit the national interests from a scientific, economic, and security perspective by supporting fundamental research on bioinspired underwater robots equipped with actively morphing fins. The research work is inspired by marine creatures that continuously change their fins' shape and stiffness to achieve optimal energy advantage for different swimming regimes. This project will study the fundamental role of active fin stiffness and shape control for the purpose of enhanced underwater propulsion. Understanding this novel swimming paradigm will allow for robotic vehicles with highly efficient operation, enabling missions with extended duration and autonomy. As a result, the new knowledge will enable the development of next generation underwater robots for scientific exploration and ecological conservation of water bodies, underwater resource prospecting and mapping, and surveillance or stealth operations for defense purposes. Through an integrated research and education plan, this project will positively impact graduate and undergraduate students and will support K-12 STEM education in the state of Nevada and beyond, with emphasis to broadening participation of underrepresented students in engineering.

The research objective of this CAREER project is to establish the bioinspired framework of unsteady fluid-structure-control interactions which will address fundamental scientific questions in dynamical systems and enable an engineering paradigm shift in soft robotic underwater propulsion. This research will contribute new understanding of the complex interplay of morphing active flexible structures and the surrounding fluid environment by synergistically leveraging structural and fluid nonlinearities via self-sensing and feedback control. Models for self-sensing and control via smart materials embedded in artificial fins will be formulated and implemented. The system coupled dynamics will be studied theoretically and experimentally characterized via image-based motion analysis and flow diagnostics. Modeling, simulations, and experiments will be translated into robotic platforms to study bioinspired locomotion and test hypotheses on the effectiveness of active morphing. This project will advance the theory of nonlinear systems with time-periodic coefficients, by investigating control-induced instabilities and complex structural resonances mediated by nonlinear hydrodynamic actions. It will elucidate the potential of harnessing vortex shedding for flow control and its relation to modulation of hydrodynamic forces and power dissipation. Furthermore, this project will advance the current state-of-the-art in underwater robotic propulsion, by exploiting the transformative concept of active stiffness and shape morphing.