IIT MADRAS & AARDO

SCHOLARSHIPS

Master of Science (M.S) by Research Programme

PROJECT DETAILS

IA-000101

DEVELOPMENT OF TRIBOELECTRIC NANOGENERATORS FOR POWERING SMALL-SCALE DEVICES

The wearable smart gadgets that are used for wireless monitoring system to continuously sense pulse, blood pressure, respiration rate plays a vital role in keeping millions of people alive and healthy. These devices are designed to be compact and work efficiently, but one of the major challenges during their operation life due to the smaller battery capacity. The pow- er consumption of such devices being in the range of µW to mW, a modified approach of recharging the fitted battery or to run the device using an alternative power source are being explored. A mechano-electric device, converts physical energy of body to electrical energy, like piezoelectric and triboelectric nanogenerators (TENG) are the first choice because of their compact nature and are studied as one of the alternative power sources. The material selection for piezoelectric nanogenerators (PENG) has great limitations due to their flexibili- ty, material processing and cost. On the other hand, TENGs, that works on triboelectrifica- tion by contact and separation of two different materials and electrostatic induction, over- comes the drawbacks and offers similar performance to that of PENG. We intend to develop flexible ceramic based nanogenerators for powering small scale devices.

IA-000102

CONVERSION OF AGRICULTURAL WASTES TO USEFUL CERAMIC PRODUCTS

Many countries around the world depend on agriculture. Agricultural wastes obviously have to be dealt with, since they consume space and can eventually lead to spreading of diseases if not disposed at the earliest. One of the possibilities to address agricultural wastes is to convert them into useful ceramics which can be used for domestic purposes or can be converted to advanced technical ceramics for industrial use. What kind of ceramics can be produced depends on the agricultural wastes. We are envisaging making from making silica to silicon carbide from these wastes. We are in touch with the tiles industry who can partner with us on this project.

IA-000103

APPLICATIONS OF AGROWASTE BASED SUSTAINABLE MATERIALS IN ELECTRIC VEHICLES

With the use of an additive manufacturing (3D printing) approach, complex-shaped parts are economically made with zero waste generation. The project involves the development of miniature parts using novel compositions for specific applications in an electric vehicle and the characterization of the parts. The effect of part inhomogeneity due to 3D printing on mechanical behavior will be investigated.

IA-000105

DATA SCIENCE AND IMAGE FUSION APPROACHES IN THE ANALYSIS OF DEMENTIC CONDITIONS

Tremendous advances in the health-care industry has led to the evolution of various imaging sensors, the data from which can be fused together to provide complementary information. This could help in improving the diagnostic accuracy and thereby, aid in the therapeutic interventions. Image fusion has become a hotspot in the diagnosis of several neurological disorders such as dementia. This proposal envisages a framework to characterize the dementic conditions using intelligent multi-modal medical image fusion approaches and analysis.

The basic components of the proposal include identification of appropriate algorithms for multi-modal image fusion, development of intelligent approaches to decouple the interdependencies among the considered modalities and computational methods suitable for patient-specific diagnostics and therapeutics of dementic conditions. Through this framework, it is also aimed to explore significant biomarkers that are indicative of the severity of dementic states using data driven algorithms.

IA-000106

CHARACTERIZATION OF MUSCLE FATIGUE IN HUMANS USING NONLINEAR SIGNAL PROCESSING TECHNIQUES AND ELECTROMYOGRAPHY

Characterizing fatigue is crucial in the fields of sports biomechanics, rehabilitation engineering, and occupational ergonomics, as it can help in preventing muscle injury due to heavy exertion. Electromyography (EMG) is a widely utilized technique to monitor the fatiguing phenomena in muscle from myoelectric activity. Analysis of EMG signals using conventional linear techniques is inadequate due to the inherent nonlinearity and non-stationarity in the signal as a result of the underlying complex physiological system. Recent advancement in nonlinear signal processing techniques is demonstrated to be effectively characterizing other complex biosignals such as electrocardiogram and electroencephalogram. The aim of the present project is to analyse the EMG signals in fatiguing contractions using various nonlinear techniques. For this purpose, EMG signals have to be acquired from the muscle under a controlled fatiguing protocol. Furthermore, appropriate nonlinear approaches to EMG signal processing are to be identified to characterize fatigue in the muscle.de identification of appropriate algorithms for multi-modal image fusion, development of intelligent approaches to decouple the interdependencies among the considered modalities and computational methods suitable for patient-specific diagnostics and therapeutics of dementic conditions. Through this framework, it is also aimed to explore significant biomarkers that are indicative of the severity of dementic states using data driven algorithms.

IA-000107

3D-PRINTING OF BIOWASTES FOR RURAL LIVELIHOOD

● Collection of bio-wastes: for example, i) Water Hyacinth and ii) Floral Wastes

● Extraction, processing and characterization of printable polymer/ Ink from collected wastes: making ready-to-print chemical extract.

● 3D printing of different ecofriendly toys, homewares, and biomedical objects with the extracts (polymers/ inks) from the wastes.

● Creating livelihood options for rural youths by providing them with training (skill development) on the above sustainable technology

IA-000108

FOOD NANO FORTIFICATION

- Food formulation
- Nanoparticles synthesis
- Fortification
- Anemic

IA-000109

DESIGN A 3-LANE 5-525MB/S CLOCK AND DATA RECOVERY WITH A FORWARDED CLOCK IN 180NM CMOS

1. Design, fabricate, and characterize a 15Mb/s-1/5Gb/s deserializer or wireline receiver IC. It recovers data from the received signal using a forwarded clock at far-end of channel and deserializes the recovered data to low-rate N bit-streams with CMOS/TTL output levels.

2. Inter Symbol Interference (ISI) due to circuit blocks with limited bandwidth, package/board parasitics, and channel is compensated with the help of equalization partly on receiver side.

The candidate will start the design process after completing basic course work at IITM.

IA-000110

THERMOGRAPHY FOR CRACK DETECTION

Combine the Laser based spot heating and Induction Thermography for detection of surface and near surface cracks in and near welds

IA-000104

MECHANICAL DESIGN WITH AGROWASTE BASED MATERIALS USING 3D PRINTING

The project involves developing sustainable composite products using FDM based additive manufacturing process and evaluation. The application domain will be electric vehicle and railway engineering.

ELECTROHYDRODYNAMICS ASSISTED MELTING

Detailed numerical investigations of isothermal melting of a dielectric phase change material in a cavity with unipolar charge injection from a circular wire electrode will be carried out. All the required governing equations will be solved in solved using the finite volume framework of OpenFOAM®. Time evolution of the melting rate, maximum flow velocity, mean Nusselt number, and mean Coulomb force in the electrohydrodynamic flow assisted melting process will be mapped. Aspect ratio of the cavity and multiple arrangements of electrodes and its position will also be investigated. The mechanism and role of electrohydrodynamic forces on influencing the net flow and melt interface morphology needs to be studied. Collected data will be used to develop a AI/ML model to arrive at a engineering based solution

IA-000112

VORTEX BREAKDOWN IN STRATIFIED FLOWS

Vortex flows are ubiquitous in nature and engineering. Wing tip vortices in aircraft, tornadoes, or flow behind propellers are examples of commonly found axial vortices. These flows present themselves with a plethora of interesting regimes. From an engineering application point of view, the control and breakdown of these vortices are of immense importance, like in swirl combustors in gas turbine engines. The proposed study is to investigate numerically using computational fluid dynamics, the breakdown phenomena in the presence of density-stratified flows, and the eventual turbulence. The various theoretical aspects of the turbulence correlations and other scale-space dynamics will also be investigated.

NEED BASED DEVELOPMENT AND DISSEMINATION OF RURAL TECHNOLOGIES

RuTaG is involved in identification, prototype design, development, testing and dissemination of several implements for rural applications. Paddy thresher, charcoal kiln, fruit decorticators, electronic Jacquard loom are a few examples from our past work. In the next phase of RuTaG starting soon, many more rural needs will be addressed by prototype development. In an unique effort, RuTaG will explore the energy requirements and potential pathways for decarbonization of energy needs in rural settings in phase-II. https://rutag.iitm.ac.in/rutag/ - check out this link for further details on projects.

IA-000114

UTILIZATION OF BIOMASS ASH IN STRUCTURAL MATERIALS

Biomass ash is an industrial byproduct of many industries which rely on biomass for power generation. Currently, huge amount of biomass ash is landfilled, posing threat to environment and health. This project explores the utilization of biomass ash in structural materials through the development of novel biomass ash-based binders.