Vertically Integrated Projects (VIP) Program

Information Packet

Spring Quarter 2021-2022

Thank you for your interest in the Vertically Integrated Projects (VIP) Program at Drexel University!

VIP team members work as part of a multidisciplinary group of undergraduate students, graduate students, research staff, and faculty members to tackle novel research and design problems around a theme. Undergraduate students that join VIP teams earn academic credit for their participation in design/discovery efforts that assist faculty and graduate students with research and development issues in their areas of expertise.

VIP teams are:

- Multidisciplinary - drawing students from all disciplines on campus;
- Vertically-integrated - maintaining a mix of freshman through PhD students each academic term;
- Long-term - each undergraduate student may participate in a project for up to three years and each graduate student may participate for the duration of their graduate career.

The continuity, technical depth, and disciplinary breadth of these teams are intended to:

- Provide the time and context necessary for students to learn and practice many different professional skills, make substantial technical contributions to the team project(s), and experience many different roles on a large, multidisciplinary design/discovery team.
- Support long-term interaction between the graduate and undergraduate students on the team. The graduate students mentor the undergraduates as they work on the design/discovery projects embedded in the graduate students' research.
- Enable the completion of large-scale design/discovery projects that are of significant benefit to faculty members' research programs.

In the following pages you will find descriptions of the following VIP teams that are recruiting for the Spring Quarter of the 2021-2022 academic year:

- Applications, Algorithms, & Architecture for Neuromorphic Computing
- Cognitive Neuroengineering for the Brain and Mind
- Deep Learning Based Optical Flow Estimation
- Measuring Air Quality with Kite-Based Sensors
- Mixed Signal Design for Neuromorphic Computing
- Robotic Sensing in Indoor Environments
- The Future of Power and Energy
- Wireless Systems for the Internet of Things

In order to participate in VIP, you must formally apply and be accepted to a specific team. To apply, please log into ForagerOne (www.drexel.edu/foragerone) and search for "VIP". This will bring up all available open positions tagged as VIP projects. When submitting an application, please be sure to have uploaded an updated résumé to your ForagerOne profile and to include a statement regarding why you are interested in working on the team to which you are applying.

Please note that VIP team participation requires registration for the accompanying VIP course section. The number of credits required per quarter is flexible and will be determined on a case-by-case basis in consultation with the team's faculty mentor and a student's academic advisor; however, most VIP team members will register for a single credit per quarter. Long-term, sustained participation in the program (three or more quarters of working on a single team) is strongly encouraged and may be required in order for earned VIP credits to count towards degree requirements. More information will be provided to all applicants that are offered a position.

Should you have any questions about a particular team, please feel free to reach out to the team's faculty mentor. Any questions regarding the VIP program in general should be sent to Chad Morris via email at cam83@drexel.edu

We hope you'll take the time to consider this compelling new opportunity. We look forward to receiving your application!

Applications, Algorithms, & Architecture for Neuromorphic Computing

Dr. Anup Das (ECE) – Faculty Mentor

GOALS

Machine learning methods such as neural networks have been successfully used in real-time computer vision and signal processing areas. Neuromorphic systems, which mimic biological neurons and synapses, can be used to implement these neural networks in energy-constrained computing platforms. The goal of this VIP project will be to facilitate the development of novel applications, new machine learning algorithms, and energy efficient computing architectures for executing machine learning tasks in hardware, commonly referred to as neuromorphic computing.

METHODS & TECHNOLOGIES

This project will use conventional machine learning tools such as TensorFlow and Theano to develop new applications and explore their performance trade-offs. The project will also use spiking neural networks simulator such as CARLsim, Brian, and Neuron. One of the methodologies we will adopt is to use recurrent neural networks architectures to process time series data. Familiarity with LSTM and Reservoir Computing will be beneficial for the project. On the hardware side, the project will investigate new architectures, especially focusing on the use of non-volatile memories to implement these machine learning tasks. Familiarity with conventional von Neumann computer architecture as well as crossbar-based neuromorphic architectures will be helpful.

RESEARCH, DESIGN, & TECHNICAL ISSUES

We will address the following challenges:

- Design of recurrent machine learning architectures for sleep apnea classification and video segmentation, using analog, rate, and spike models
- Design of unsupervised approaches to anomaly detection, example in reference to abnormal heart-beats, a pre-processing step towards arrhythmia detection. Another example is the predictive visual pursuit.
- Design of new algorithms that enhance the capability for existing algorithms, such as spike-timing dependent plasticity, Force, etc.
- Develop compiler tool chains to translate a user's machine learning program to low-level languages that can be interpreted by neuromorphic systems.
- Develop Operating System like framework that will allow programmers to easily deploy their machine learning programs on neuromorphic systems.

MAJORS & AREAS OF INTERESTS

This VIP team is interested in recruiting both undergraduate and graduate students from the following majors and/or with a background and interest in the areas listed below.

- Electrical & Computer Engineering – computer architecture, signal processing, machine learning
- Computer Science – machine learning, game design and visualization, data science, software
- Sociology – human factors, technology adoption
- Business – business analytics, marketing, decision sciences
- Economics – smart CRM; customer experience; optimization of employee, inventory, and store layouts

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Distributed, Intelligent, and Scalable Computing (DISCO) Lab

PARTNERS & SPONSORS

IMEC Netherlands, UC Irvine, ETH Zurich

Cognitive Neuroengineering for the Brain and Mind

Drs. John Medaglia (PSY) & Gary Friedman (ECE) – Faculty Mentors

GOALS

Just like any other part of the body, brains are unique to the individual and change over time. Anatomical MRIs (magnetic resonance imaging) show very clear differences in the shape and position of different landmarks, lobes, etc. in different peoples' brains. But there are also many differences that are not evident from visual inspection of anatomical images. Using fMRI (functional MRI), we are able to see which areas become more or less activated during a certain task. This allows us to make a functional connection between a behavior or performance and regions of the brain. For example, fMRI has allowed us to associate the frontal areas of the brain with executive control, which is the ability to choose between options and make plans. Like anatomy, the location of these functional areas varies across individuals. Even more, functional areas are part of greater networks throughout the brain. These networks connect and exchange information in order to execute tasks. For example, the "frontoparietal control network" (FPCN) is a network that links frontal and posterior areas of the brain and is especially important in helping us to switch between different tasks based on the context of our environment or rules. Networks vary across individuals in the same way that functional areas do.

As described above, there are individual differences at many levels within the brain. i.e. at the anatomical, functional, and network levels. Our lab uses a combination of MRI, functional MRI, diffusion MRI (which maps brain connectivity), EEG, graph theory, and network control theory to create individual-level functional maps of a person's brain. We pair these maps with TMS (transcranial magnetic stimulation) and tDCS (transcranial direct current stimulation) to stimulate the brain in order to learn about how functional networks connect and to develop and inform treatments for brain disorders. TMS and tCDS are non-invasive brain stimulation technologies, meaning that they can influence how neurons fire, harmlessly, from outside the body. TMS achieves this through the application of strong magnetic fields and tCDS achieves this through direct low-intensity electrical currents. A unique advantage of brain stimulation allows us to make causal connections between brain activation and behavioral outcomes, which was previously only possible using invasive techniques or by studying those with brain damage due to injury.

However, TMS and tCDS are often used in treatments without any information about underlying neural circuits and network organization, i.e. using anatomical landmarks. Our lab uses the fMRI methods described above to create detailed and personalized functional networks to guide stimulation to test whether we can induce improved behavioral responses. Another aspect of targeting neural stimulation is synchronizing it to the activity in the relevant networks. Our lab uses Electroencephalography (EEG) to measure what happens in subjects' brains while they complete tasks. We use extremely fast "closed-loop" systems to deliver neural stimulation that can enhance or suppress brainwaves in the targeted networks. Together, personalized targeting in space ("where" in the brain) and in time (synchronizing with ongoing brain waves from functional networks) can help us to identify optimal stimulation strategies that lead to better treatment plans and better patient outcomes

METHODS & TECHNOLOGIES

Many different methods and technologies are used at each step of our research. Our typical process is to design appropriate MRI tasks and scan sequences; bring the subject into the scanner; process their imaging data and create personalized stimulation targets; create cognitive/behavioral tasks that test the function of interest; noninvasively stimulate the subject at their personalized target and analyze their results. Some steps are more design-focused with an emphasis on cognitive psychology, some are more technically focused such as creating tasks and setting up equipment, some are more subject-focused, i.e. running sessions, and some are more programming-focused, such as neuroimaging data processing and analysis. In general, most of our time is spent doing processing and analysis on computers, and the rest is spent in-person running sessions. Experience with and interest in any of the following will be relevant to our research.

- Computer-guided behavioral testing of humans
- EEG (electroencephalography)
- MRI (magnetic resonance imaging)
- Transcranial magnetic stimulation (TMS)
- Transcranial direct current stimulation (tDCS)
- Statistical data analysis (Matlab, Python, R, etc.)
- Neural network models
- Any EEG or MRI preprocessing suite (FreeSurfer, SPSS, FSL, fMRI prep, EEGLab, ERPLab, FieldTrip, etc.)
- Using the Command Line
- Signal Processing
- Cloud Computing, Supercluster computing, Supercomputer computing (Azur, AWS, Google Cloud, University Clusters, regional sites) and knowledge of computing resources for research beyond Drexel
- Windows, Mac, and Linux operating systems
- Computer Hardware/Design, including adding hard drives, expansion cards, memory, etc., upgrading internal components, RAID configuration, and technical specifications such as cable shielding, data transfer rates and certifications, Monitor metrics such as ppi, refresh rate, viewing angle, motion artifacts, etc.

RESEARCH, DESIGN, & TECHNICAL ISSUES

In general, VIP team members will be involved in both running in-person research sessions and in analysis, processing, and design. The lab will work closely with incoming VIP students to understand their interests and goals and align their time and efforts with appropriate projects. At any given time, the lab has multiple ongoing projects in various stages of development.

MAJORS & AREAS OF INTEREST

This VIP team is interested in recruiting both undergraduate and graduate students from the following majors and/or with a background and interest in the areas listed below.

- Electrical Engineering - EEG and MRI signal detection and processing, modeling of field penetration into the brain, neural network models, statistical signal processing
- Computer Engineering - software for behavioral tests, implementation of testing protocols over internet, neural network modeling, statistical signal processing
- Psychology - development of behavioral tests, interpretation of EEG data, development of TMS and TDCS protocols, neural network modeling
- Biomedical Engineering - EEG and MRI signal detection and processing, modeling of field penetration into the brain, neural network models, statistical signal processing
- Computer Science - software for behavioral tests, implementation of testing protocols over internet, neural network modeling, statistical signal processing

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PARTNERS & SPONSORS

None

Deep Learning Based Optical Flow Estimation

Dr. Anup Das (ECE) – Faculty Mentor

GOALS

Optical flow or optic flow is the pattern of apparent motion of objects, surfaces, and edges in a visual scene caused by the relative motion between an observer and a scene. Optical flow can also be defined as the distribution of apparent velocities of movement of brightness pattern in an image. [Source: Wikipedia]

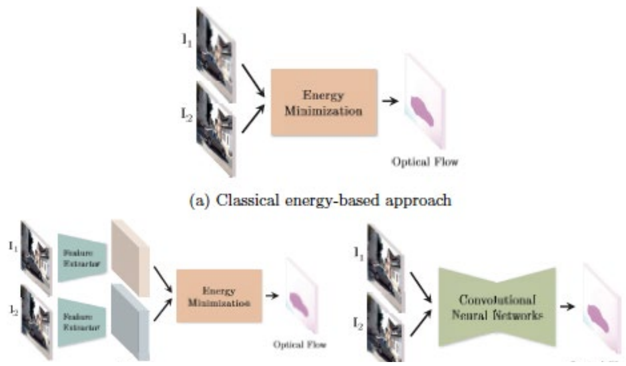

Figure 1: Comparing Classical approach vs. using CNN for optical flow estimation. (Source: Hur et al., arXiv 2020)

As in many subareas of computer vision, recent advances in deep learning have also significantly influenced the field of optical flow. The following figure shows the difference between a classical energy-based optical flow estimation, and that using deep learning approaches such as the convolutional neural networks (CNNs).

To this end, researchers have proposed FlowNet (https://github.com/NVIDIA/flownet2-pytorch) is the first work that demonstrated an end-to-end CNN regression approach for estimating optical flow based on an encoder-decoder architecture.

The Drexel's Distributed, Intelligent, and Scalable COmputing (DISCO) lab is looking for VIP student engineers to develop deep learning techniques for optical flow estimation. This is a joint project between Drexel University and Imec, Leuven. The VIP students are expected to explore conventional and non-conventional machine learning algorithms using to enable optical flow estimation. The work will also involve data preprocessing, feature, extraction, as well as building new learning architectures. The VIP students are expected to work with professors, post-docs, and phd students. The student will have weekly meeting with the entire team to discuss progress. There will be opportunity for publications at top machine learning venues.

METHODS & TECHNOLOGIES

This project will use conventional machine learning tools such as Keras and PyTorch to develop baseline optical flow estimation. Students will work on fine-tuning the model hyper-parameters, such as convolution layers, kernel size, etc. The project will also use two non-conventional approaches, such as that using unsupervised machine learning and spiking neural networks (SNN) to design optical flow estimation. To this end, students will SNN simulators such as Brian, and Neuron to train SNNs. Finally, students will work on mapping the SNN onto to neuromorphic hardware, using tools developed in the DISCO lab.

RESEARCH, DESIGN, & TECHNICAL ISSUES

This team will address the following challenges:

- Design of machine learning architectures for optical flow, using analog, rate, and spike models.
- Model hyper parameter tuning and exploration of the search space using greedy heuristics.
- Design of new spiking algorithms that enhance the performance for optical flow.
- Mapping spiking-based models of optical flow to neuromorphic hardware

MAJORS & AREAS OF INTERESTS

This VIP team is interested in recruiting both undergraduate and graduate students from the following majors and/or with a background and interest in the areas listed below.

- Electrical & Computer Engineering –signal processing and machine learning
- Computer Science – machine learning, data science, software

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PARTNERS & SPONSORS

IMEC Netherlands, KU Leuven

Measuring Air Quality with Kite-Based Sensors

Dr. Richard Cairncross (CBE) – Faculty Mentor

GOALS

Kites are a potentially lower-cost and more publicly acceptable alternative to drones for some applications of atmospheric and environmental monitoring. This project is part of a collaboration with NASA and other researchers to developed improved systems for profiling atmospheric conditions and wind within the Planetary Boundary Layer (PBL) and Surface Layer. This project is funded by NASA through the AREN project (AREN Project - AREN Project - GLOBE.gov).

PROJECTS FOR SPRING/SUMMER 2021-2022

The following is a list of projects that VIP students will be working on during Spring and Summer quarters of 2021-2022:

- Construction of model kites using 3D printing and other construction techniques for measurement of aerodynamic coefficients in a wind tunnel and comparison of the measured aerodynamic coefficients to published values, simulations, and models. Modification of the kite geometry to improve aerodynamic performance characteristics such as lift-to-drag ratio and stability
- Construction of dataloggers (based on Arduino or Raspberry-Pi) for recording forces and orientation of kites and atmospheric conditions (temperature, wind speed, etc.) during field testing. Analysis of field data collected simultaneously from multiple sensors to evaluate kite performance and quantify wind variations in the surface layer.
- Wireless communication between sensors in a network with upload of data to the cloud for visualization and archiving of data.
- Modeling forces and torques acting on kites and kite systems to predict performance and relate the performance to measured aerodynamic coefficients and field observations
- Developing educational modules to use kites as a vehicle for STEM education for middle school and high school students

CURRENT AND PAST PROJECTS

The following is a list of example projects that VIP students have worked on in this project. Some of these projects are ongoing:

1. Development of wireless sensor networks for field data collection using Arduino-based microprocessors and LoRa radio technology. Prior work on this project has implemented datalogging with a single Arduino and SD card; recently we have worked with Adafuit Feather units to communicate between a sensor node (mounted on a kite) and a base node (at ground level) to obtain real-time field data from the kite and datalogging relevant data for later analysis. The previous system is rudimentary and will be upgraded using the ArduinoJson library and more robust communication protocols and real-time data visualization.
2. Connection of wireless sensor network for data uploading to the cloud. We plan to use Wi-Fi hotspots or cellular data to connect to Amazon Web Services using IoT and MQTT protocols for archiving of field data and live-streaming data to web applications. Streaming data directly to the web also protects against loss of data due to failure of kite system components.
3. Construction of data analysis tools for parsing field data (from cloud or SD card or serial output) into relevant parameters and graphics. This can be done through importing data into Excel, MATLAB, or other data analysis tools. Data analysis will be used to evaluate kite aerodynamics and stability and to provide quantitative comparison of data collected between different locations and under different field conditions.
4. Raspberry-Pi-based video system with streaming directly to YouTube or another video service and subsequent (or real time) synchronization of video with a datastream. Kite Aerial Photography (KAP) is common for obtaining aerial images that are useful for evaluating environmental conditions. KAP can also be used for structure from motion analysis and monitoring of the kite system components.
5. Mathematical modeling of the physics of kite systems to enable evaluating alternative kite system designs and identify important parameters for field testing. We currently have an Excel-based model of 2D static kite pitch equilibrium (a model of forces and torques versus the angle of attack of the kite) which incorporates multiple lifting surfaces, variable center of gravity, variable bridle geometry, and variable tail geometry. This model can be expanded and used to analyze field data for more accurate estimates of the aerodynamic

coefficients (lift, drag, center of pressure). We will also explore expansion of the model to improve systems similar to those envisioned for long-term applications (with multiple kites, steerable kites, line climbing kites) and to evaluated kite system dynamics; these models could be implemented through Wolfram System Modeler, MATLAB Simscape Multibody, or customized systems models.

6. Evaluation of kite systems (either physical prototypes or mathematical models) including variable bridling systems (to control lift/drag forces and enable steerability or altitude control), line-climbing kites, ultra-light kites, Evan's loop lifting systems (where a pully is attached to the kite line enabling lifting the sensor platform after the main kite is flying at a stable altitude), measuring line tension, line inclination, and angle of attack of kites in the field.

METHODS & TECHNOLOGIES

Data acquisition, wireless communication, Internet-of-Things connection protocols, GPS location tracking, mathematical modeling, systems statics and dynamics, computer programming (Arduino C++, Java, Python, MATLAB, Mathematica), web programming (Java, AWS, MQTT, Json), air quality sensors, power management, mechanical design, motor control, tension measurement, flight dynamics, flight control, aerodynamics, software design, systems analysis.

RESEARCH, DESIGN, & TECHNICAL ISSUES

The proposed kite-based environmental monitoring and mapping system includes several sub-systems that all need to be designed to function for integration into the system. The lifting sub-system in the kite provides lift; the use of stunt kites also enables maneuvering within a three-dimensional wind window downwind of the anchor point. The flight control sub-system modifies tension on multiple lines and controls both the kite orientation and location. An "Evans Loop" ground tether involving two motors on the ground enables deploying a kite to achieve stable flight, and later lifting a sensor platform or air sampling system. The aerodynamically-stabilized sensor platform houses microprocessors to collect data from multiple lightweight sensors. The air sampling sub-system suspends an air sampling tube from the kite tether and then pumps air to equipment on the ground.

MAJORS & AREAS OF INTEREST

This VIP team is interested in recruiting both undergraduate and graduate students from the following majors and/or with a background and interest in the areas listed below.

- Mechanical Engineering – aerodynamics, systems analysis, motors, robotics, mathematical modeling
- Electrical & Computer Engineering and Computer Science - wireless communication, cloud computing, synchronization of data-logging with video and GPS measurements, display of data
- Other students with programming/IoT/web processing/microprocessor (Arduino Raspberry Pi)/GIS/mathematical modeling experience
- Other students with interests in applications of environmental engineering and science are welcome to apply

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PARTNERS & SPONSORS

Collaborators: Geoff Bland (NASA/Goddard Space Flight Center); Gabriel Ladd (consultant); Douglas Stout (Falcon Aero Designs); AEROKATS and ROVER Educational Network (AREN)

Funding received from:

- Environmental Protection Agency, P3 (People Prosperity and the Planet) Award (https://www.epa.gov/P3)
- NASA, AEROKATS, AREN projects (https://www.globe.gov/web/aren-project/overview/aerokats, http://www.iccarsproject.net/resources/remote-sensing-resources/nasa-aerokats, https://science.nasa.gov/science-activation-team/resa)

Mixed Signal Design for Neuromorphic Computing

Dr. Anup Das (ECE) – Faculty Mentor

GOALS

Open-source FPGA based emulation environment for neuromorphic computing research. Neuromorphic systems, which mimic biological neurons and synapses, can be used to implement these neural networks in energy-constrained FPGA platforms. The goal of this VIP project will be to facilitate the development of novel applications, new digital design techniques, and energy efficient computing architectures for executing hardware, commonly referred to as neuromorphic computing.

METHODS & TECHNOLOGIES

This project will use FPGA tools such as Vivado and Quartus to develop new applications and explore their performance trade-offs. The project will also use digital hardware design techniques such as VHDL and Verilog. One of the methodologies we will adopt is to use neural networks architectures to process time series data. On the hardware side, the project will investigate new architectures, especially focusing on the use of non-volatile memories to implement these hardware implementation tasks. Familiarity with analog design knowledge based neuromorphic architectures will be helpful.

RESEARCH, DESIGN, & TECHNICAL ISSUES

We will address the following challenges:

- Integration of sensors and cameras with the neuromorphic system in an architecture involving FPGA
- Modern neuromorphic processors provide high performance while using minimal power for tasks like vision-based rover navigation, entry-descent-and-landing, sensor fusion, or on-board decision making
- Develop compiler tool chains to translate a user's machine learning program to hardware description languages that can be interpreted by neuromorphic systems.
- Develop Operating System like framework that will allow programmers to easily deploy their FPGA programs on neuromorphic systems.

MAJORS & AREAS OF INTERESTS

This VIP team is interested in recruiting both undergraduate and graduate students from the following majors and/or with a background and interest in the areas listed below.

- Electrical & Computer Engineering – FPGA development, electronics design and debugging

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PARTNERS & SPONSORS

None

Robotic Sensing in Indoor Environments

Dr. James Lo (CAEE) – Faculty Mentor

GOALS

The goal of this team is to implement hardware/software developments related to the autonomous robotic platform which will host a variety of sensing package for indoor environmental quality.

METHODS & TECHNOLOGIES

Hardware development, software design, signal processing, data acquisition and analytics, building physics

RESEARCH, DESIGN, & TECHNICAL ISSUES

Indoor environmental sensing traditionally has been hampered by high cost in installation and power requirements. By integrating sensing packages with autonomous vehicles (both land and air vehicles), a novel approach of data acquisition without wired installation can be realized; however, both the robotic platform and sensor package still face key challenges when considering them as tools for both building designers and engineers. Therefore, research in this VIP section will be separated into two areas: 1) extension of current robotic platform capability for indoor navigation and deployment and 2) improvement of wireless sensor packages for a wide range of data acquisition. Design of customized robotic vehicles and hands-on experience will be an integral part of this team, as well as building various sensor modules for indoor environmental parameters. An additional objective will be the post-processing of data obtained by sensors as a means for further development of indoor sensing strategies.

MAJORS & AREAS OF INTERESTS

This VIP team is interested in recruiting sophomore to pre-junior undergraduate students to be part of the following three areas.

- Rover development - some background on rover and ROS, some hardware skills (pin connection, soldering, etc)
- Drone development - software development in Python and TCP/IP socket programming
- Sensor development - Arduino programming and hardware skills

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PARTNERS & SPONSORS

National Institute of Standards and Technology - Energy and Environment Division

The Future of Power and Energy

Dr. Fei Lu (ECE) – Faculty Mentor

GOALS

The goal of this team is to acquire the theoretical knowledge and hand-on skills in electrical power and energy needed to affect the future of the field. Undergraduate team members will be trained in both fundamental and advanced technologies in power electronics; moreover, together with the graduate team members, undergraduate team members will investigate cutting-edge research topics in electrical power and energy.

METHODS & TECHNOLOGIES

Power electronics circuit design, three-dimension electromagnetic fields simulation, finite element analysis (FEA), thermal design, intelligence design, connected and automated vehicles, electric vehicles, autonomous driving

RESEARCH, DESIGN, & TECHNICAL ISSUES

Modern power electronics system design aimed at addressing problems in the future power and energy need to be highly efficient, compact in size, low cost, reliable, and operate intelligently. To achieve these features, team research will chiefly move in two directions: 1) circuit hardware design, including the notable circuit topology of power conversion; and 2) system management design, including algorithms for controlling predesigned circuits.

MAJORS & AREAS OF INTEREST

This VIP team is interested in recruiting both undergraduate and graduate students from the following majors and/or with a background and interest in the areas listed below.

- Electrical & Computer Engineering - power electronics, power system, motor driving, circuit simulation, finite element analysis, electromagnetic field analysis, experimental experience
- Mechanical Engineering - electromechanical system design, thermal design, structure design, computer aid design (CAD) software experience
- Computer Science - software development, embedded system programming
- Materials Science & Engineering - magnetic material analysis, dielectric material analysis
- Chemical Engineering - electrochemical analysis, power battery design and analysis

MENTOR CONTACT INFORMATION

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Professional Profile

PARTNERS & SPONSORS

None

Wireless Systems for the Internet of Things

Dr. Kapil Dandekar (ECE) – Faculty Mentor

GOALS

The future Internet of Things (IoT) will consist of a large number of wireless devices and sensors with profound implications for the economy and society. The Drexel Wireless Systems Lab (DWSL) is focused on developing new experimental wireless transceivers and sensors for future IoT networks. These systems require a wide variety of protocols (wireless local area networks, radio frequency identification, Zigbee, Low-power wide area networks, real-time localization systems, etc.) which can be implemented using flexible software defined radios (SDR) in DWSL. Target applications include: applications of radio frequency identification (RFID), wearable transceivers for biomedical sensing, smart grid and smart city infrastructure, effective omni-channel retailing, real-time localization, collaborative intelligent radio networks.

METHODS & TECHNOLOGIES

Software defined radio, wireless communications and networking, signal processing, machine learning, antenna and wireless transceiver design, augmented reality, cybersecurity, unmanned aerial vehicles

RESEARCH, DESIGN, & TECHNICAL ISSUES

Using RFID and sensors for biomedical sensing and real-time localization, wireless networks and sensors for smart infrastructure applications enabling a smart and connected omni-channel approach in retail environments, software defined radio for collaborative intelligent radio design, research and education with competition-based radio networks, cybersecurity for wireless networks, unmanned aerial vehicle communications and sensing

MAJORS & AREAS OF INTEREST

This VIP team is interested in recruiting both undergraduate and graduate students from the following majors and/or with a background and interest in the areas listed below.

- Electrical & Computer Engineering - wireless communications and networks, signal processing, machine learning
- Computer Science - software defined radio, machine learning, game design and visualization, cybersecurity
- Sociology - human factors and technology adoption
- Business - business analytics, marketing, decision sciences
- Economics - smart CRM; customer experience; and optimization of employee, inventory, and store layouts

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PARTNERS & SPONSORS

Currently in discussions with Comcast machineQ, Impinj, and Centrak