

# Chiniot-Faisalabad Campus



## Director

**Dr Shahzad Sarfraz**

Professor

HEC approved PhD Supervisor

PhD (CS), AIT, Thailand (2012)

MSc (CS), Univ of Agri., Faisalabad (2006)

BCS, Univ. of Punjab, Lahore (2004)

Situated at the junction of Pakistan's Textile Capital—Faisalabad and the historically rich city of Chiniot in suburbs of River Chenab, the Chiniot-Faisalabad campus is the 5th campus of the university. The campus symbolises the desirable connect between nature and industry and between tradition and modernity. Its picturesque surroundings in the outskirts of Pakistan's Manchester, the home to textile industry, represent human advancement from agrarian to industrial and technological society. The campus is located on 22-acres of land on Faisalabad Sargodha Road (about 9 km from M4 Motorway Faisalabad interchange towards Chiniot).

The Campus has been established to carry forward the academic traditions of excellence in professional and personal aspects of the students. The aim is to follow the footsteps of the alumnae of the 4 sister campuses in Islamabad, Lahore, Karachi, and Peshawar. Graduates of all sister campuses of this university are well-received by the industry and hold prominent positions in many national and multinational corporations. A large number of university alumni are serving in prestigious institutions and organizations across the world like Google, Facebook, Microsoft, YouTube, Oracle, NCR, LMKR, IBM, and many more. The Campus has changed the technological landscape of Faisalabad with high number of Technology start-ups. The physical proximity of the Campus with some of the leading industrial enterprises will

go a long way in furthering the cause of professional education in the country.

The campus offers degree programs in Computer Science, Electrical Engineering and Business Administration. To confer academic excellence on its graduates, the campus has scholarly, seasoned, dedicated, and professionally stimulated faculty. The campus has state of the art computing, engineering, and other support facilities. Spacious and well-equipped computer and engineering labs impart practical orientation to the students in their respective areas of study. Audio-visually supported and well-furnished classrooms offer a favourable, conducive, and constructive learning environment to the students.

The Campus other than academics offer a very vibrant student life in order to contribute towards the personality development of the students. extends sports facilities in both indoor and outdoor games like cricket, football, badminton, table tennis, volleyball, basketball, futsal, and chess. Besides sports, healthy competitions in the fields of information technology, business and arts are frequently organized by the campus.

The University aims at making this campus a centre of excellence in application of information and communication technology in agriculture and other emerging Industries.

## Programs offered at Chiniot-Faisalabad Campus:

BBA

BS (Artificial Intelligence)

BS (Business Analytics)

BS (Computer Science)

BS (Electrical Engineering)

BS (Software Engineering)

MBA

MS (Computer Science)

MS (Electrical Engineering)

PhD (Computer Science)

PhD (Electrical Engineering)



# Research

## Department of Computer Science

### 1. Spatial Analytics Research (SAR) Group

Spatial Analytics Research (SAR) Group is led by Dr. Shahzad Sarfraz. SAR group is a multidisciplinary research group established at the department of Computer Science at National University of Computer and Emerging Sciences (NUCES-CFD).

Our research explores socioeconomic, demographic, Big Data and relating them to more conventional and well-grounded data infrastructures. Our primary motivation is to visualize, understand, and predict the location and dynamics of human behaviour along with natural phenomena's. The Group focuses on research and education with regards to Geographical and Spatial Analysis as well as locational planning. SAR Group provides access to hardware, software, and data to conduct research related activities. Besides providing facilities the group is also providing research project consultations. Moreover, we are also focusing in developing platforms for use with open source and proprietary GIS systems. SAR's goals are to advance the science and technology of GIScience and earth observing that can further lead to the transdisciplinary application of spatial data science solutions for addressing novel and impactful research questions. We host an active research group that will serve as a platform to foster in the domain of Remote Sensing and GIS. SAR is comprised of innovators and trailblazers in the fields of GIScience and spatial analysis. Currently, the student members of this group are working in the following areas.

1. Prediction of disease and crime spread.
2. Career progression trajectory prediction.
3. Temporal and spatio-temporal sentimental analysis for tourist attraction recommendation.
4. Prediction of pollution and its effects on health using remote sensing images and machine learning approaches.
5. Detecting and exploring spatio-temporal profiles of lifestyles and activity patterns.
6. Soliciting, triangulating, and analyzing crowd-sourced volunteered data that link physical and virtual identities.

### Partnerships and collaborations

Whilst much of our research is HEC funded, we also undertake research in partnership with several public and private sector institutions. Currently, this group is also running NRP funding of worth 4.87 million.

### Research Group Members:

1. Prof. Dr. Shahzad Sarfraz
2. Dr. Qamar Uzaman
3. Mr. Adeel Ashraf Cheema
4. Mr. Usman Joyia
5. Mr. Usman Ghous
6. Mr. Awais Azam

For More Information visit website link <https://sar.org.pk/home/>

### 2. Machine vision and Knowledge representation (MvKr)

The Machine Vision and Knowledge representation (MvKr) group has been initiated under the supervision of Dr. Muhammad Ahmad. MvKr group at the Department of Computer Science, FAST NUCES CFD Campus is dedicated to performing research in the areas of Spectral Imaging (e.g., Hyperspectral Imaging, Remote Sensing), Machine Learning, Computer Vision, and Wearable Computing. Our goal is to create an intersection between various disciplines. The research group is working in the following fields:

**Spectral Imaging:** Hyperspectral Imaging (HSI) is concerned with the extraction of meaningful information based on the radiance acquired by the sensor at short or long distances without substantial contact with the object of interest. HSI provides detailed spectral information by sampling the reflective portion of the electromagnetic spectrum covering a wide range of 0.4-2.4 m (i.e. visible 0.4-0.7m to short wave infrared 0.7-2.4m) region in hundreds of narrow and contiguous spectral bands. HSI can also explore the (light) emission properties of objects in the range of mid to long infrared regions.

Despite the detailed information, it brings several challenges since traditional analysis techniques for monochromatic, RGB, and multispectral images cannot be directly exploited to extract meaningful information from Hyperspectral ones due to several reasons, e.g. HSI exhibits the unique

statistical and geometrical properties of high dimensional spectral/spatial data, i.e. the volume of a hypercube and hypersphere concentrates on corners and outside shells respectively.

In a nutshell, HSI provides a large set of information hidden to the naked eye and have a wide range of real-life applications e.g., atmosphere, environmental, urban, agriculture, geological, mineral exploration, coastal zone, marine, forestry (i.e. track forest health), water quality and surface contamination, inland waters, and wetlands, snow and ice, biological, medical contexts, and food processing. There are also several military applications in camouflage, landmine detection, and littoral zone mapping. Furthermore, HSI has been used in space, air, and underwater vehicles to acquire detailed spectral information for a wide range of uses.

**Research Areas:** Hyperspectral Image Classification (Man-made Material Classification, Red-chili Adulteration Detection/Classification, Minced Meat Adulteration Detection/Classification, Prediction of Microbial Spoilage in Bakery Products, Bloodstain identification, and Explosive Material identification.), Object/Change Detection (Static/Dynamic), Spectral Unmixing, Super Resolution (Resolution Enhancement), Restoration and Denoising, Dimensionality Reduction (Feature Selection/Learning for Classification), Hyperspectral Pansharpening.

**Machine Learning (ML) / Deep Learning (DL):** Machine Learning (ML) aims to enable computers to learn from the world (Data/Information) around them and it has revolutionized the world in the last few years. Deep Learning, a particular method of ML, has played a crucial

role in enabling several real-life applications such as autonomous vehicles, auto caption generation, image to video generation, recommendation systems, security & surveillance, object detection and recognition, and object tracking, etc. Though substantial advancements have already been made in the development of ML/DL algorithms and their underlying theory, several challenges remain unaddressed. Our research focuses on finding answers to the following problems.

**Research Areas:**

1. **Complex Training Process:** Training of Deep Neural Network (DNN) and optimization by tuning parameters is an NP-complete problem where the convergence of the optimization process is not guaranteed. Therefore, it is assumed that training of DNN is very difficult especially in the case of big data when a large number of parameters need to be adjusted/tuned.
2. **Limited Availability of Training Data:** Supervised DNN requires a considerably large amount of training data otherwise their tendency to overfit increases significantly leads to the Hughes phenomena. The high dimensional characteristic of data coupled with a small amount of labeled training data makes the DNNs ineffective for HSIC as it demands a lot of adjustments during the training phase.
3. **Model's Interpretability:** The training procedure of DNNs is difficult to interpret and understand. The black box kind of nature is considered as a potential weakness of DNNs and may affect the design decisions of the optimization process. Although, a lot of work has been

done to interpret the model's internal dynamics.

4. **High Computational Burden:** One of the main challenges of DNN is dealing with a big amount of data that involves increased memory bandwidth, high computational cost, and storage consumption.
5. **Training Accuracy Degradation:** It is assumed that deeper networks extract more rich features from data, however, this is not true for all systems to achieve higher accuracy by simply adding more layers. Because by increasing the network's depth, the problem of exploding or vanishing gradient becomes more prominent and affects the convergence of the model.

**Research Group Members:**

1. Dr. Muhammad Ahmad
2. Mr. Muiz Qadir
3. Mr. Usman Ghous
4. Ms. Momina Tayyaba

**Delta Research (Delta-R) Group**

Delta research group is serving under the supervision of **Dr. Muhammad Umar Aftab**. Delta-R is a multidisciplinary research group established at the department of Computer Science, National University of Computer and Emerging Sciences (NUCES-CFD). Our goal is to create an intersection between various disciplines. Expert faculty having extensive experience in both academia and research are leading the research team according to their area of expertise. In addition, a team of dedicated students is also working under the umbrella of this group. Our group mates are working in the following fields:



## Delta-R towards Secure Systems

**Access Control:** A secure mechanism to enforce the access decisions and various models are there to implement access control such as role-based access control, attribute-based access control. Our team is working on hybrid access control models. In addition, access control models are considered a good choice with the SCADA dataset for IoT-enabled platforms.

**Cryptography:** We are currently working on access control in IoT to achieve user authentication and data privacy. We can achieve authentication using the signcryption technique, and through encryption, we achieve data privacy using certain cryptographic techniques such as the Elliptic curve and Hyperelliptic curve. We are also working on the incremental cryptographic technique for block modification to obtain efficient and low-cost results.

**Image Steganography:** Image steganography is a branch of information security that is used to conceal secret information in images. The image steganography can be used to share secret data like documents and keys of cryptography. The output image having secret information is called stego image. The objective and challenge of image steganography are to generate stego images with a high secret information payload and minimum noise of modification.

## Delta-R towards Wireless and Computer Networks

With the help of **smart sensor networks and the Internet of Things (IoT)**, physical phenomena in the real world should be monitored and connected with the digital world, without the unnecessary intervention of the monitored processes. In addition, **Edge computing** is an emerging distributed computing paradigm in which computations are mostly performed on distributed device nodes known as smart devices or edge devices as opposed to primarily taking place in a centralized cloud environment.

1. End Nodes Control and Monitoring Applications
2. End Nodes Mobility Management.
3. End Nodes Task Offloading Management
4. Energy Efficient Solutions for Resource Sensitive Networks
5. Geolocation-Aware Data Distribution.
6. Batch Processing with Real-Time Processing Comparisons.
7. Edge Network Expandability and Scalability

### Research Group Members:

1. Mr. Adeel Ashraf Cheema
2. Mr. Muhammad Usman Joyia
3. Mr. Usman Ghous
4. Ms. Momina Tayyaba
5. Mr. Junaid Hassan
6. Mr. Ali Hamza
7. Mr. Haider Ali
8. Mr. Fahad Javed
9. Ms. Aqsa Ghani
10. Ms. Umara Rana

## Partnerships, collaborations, and Funded Projects

Our research group successfully got the funding against FRSG-2021(Faculty Research Support Group) worth 0.7 Million rupees. In addition, our group is working with our Chinese collaborators against International Scientific and Technological Innovation Cooperation Project in Sichuan Province (Project ID 2020YFH0062) worth 0.2 Million RMB.



## Department of Electrical Engineering

### Centre for Advanced Research in Energy (CARE),

CFD Campus, Chiniot is focusing on addressing the Challenges faced by the Energy Sector of Pakistan that includes i.e. developing a roadmap for “Solar Systems Engineering Laboratory” to educate students, practicing engineers, technicians, and researchers through training, development, and research experiences in areas related to solar energy systems engineering and developing low cost micro grids to sustainably electrifying the remote communities, developing isolated electric vehicle charging stations and introducing low cost sodium-ion batteries in Pakistan through a Project Titled “Isolated Smart Microgrids for Remote Communities and Electric Vehicles Charging by using Earth Abundant Energy Storage Materials: Planning, Design and Control”.

#### Collaborations (National):

- Syed Babar Ali School of Science and Engineering (SBASSE), Lahore University of Management Sciences (LUMS), Lahore
- U.S. Pakistan Centre for Advanced Studies in Energy (USPCASE), National University of Science and Technology, Islamabad
- Sino-Pak Centre of Artificial Intelligence (SPCAI), Pak-Austria Fachhochschule: Institute of Applied Sciences and Technology (PAF-IAST), Haripur
- Department of Materials Science and Engineering, Institute of Space Technology, Islamabad
- Tesla Industries (Pvt) Ltd
- Strongmen Industries (Pvt) Ltd
- OMECTA International (Pvt) Ltd
- Faisalabad Chamber of Commerce and Industry (FCCI), Faisalabad

### Collaborations (International)

- Battery Technology Centre, Samsung SDI America Inc.
- Department of Chemical and Petroleum Engineering, University of Calgary, Canada.
- State Key Laboratory of Advanced Electromagnetic Engineering and Technology (AEET), HUST, China

#### Dr. Muhammad Shoab Khalid

Professor EE is Head of CARE Research Lab

### AI, Intelligent Machines and Systems (AIMS) Lab

AIMS Lab focuses on applied research using emerging technologies such as Artificial Intelligence (AI) and Internet of Things (IoT) for solving real-world problems. Industry 4.0 refers to the concept of enabling smart factories, smart cities and smart society in general using the fusion of cyber and physical world. The vision is to have smart connected machines augmented with wireless connectivity and sensors. The goal of AIMS Lab is to conceive, design and develop AI based embedded/IoT systems that can recognize and understand their environment to make informed decisions and provide actionable insights. The demand of developing intelligent automation systems using advanced engineering and innovative technologies is increasing. The team of AIMS Lab is developing industrial automation solutions using advanced engineering principles and with the help of innovative approaches. For this purpose, we closely work with our collaborators from industry and academia. We have developed state-of-the-art labs and experimentation setup in different domains of electrical engineering.

AIMS Lab is working on different external and internal funded projects. We are working on Computer vision based projects for automation of tasks such as automatic vehicle license plate detection, face

recognition, tracking and human activity detection. We are also developing IoT based solutions for warehouse automation, energy management and industrial process monitoring. AIMS Lab is also working on a project funded by National Center for Robotics & Automation (NCRA).

### Funded R&D Projects

- Warehouse Automation of a Textile Factory using Industry 4.0 Technologies. The project has total approved fund of Rs. 13.127 Million for duration of 1.5 years.
- Design and Implementation of an Autonomous Multi-Unmanned Air Vehicle (UAV) System Using a Hardware-In-The-Loop (HIL) Real-Time Platform. The project has total approved fund of Rs 4.1 Million by HEC for duration of 3 years. (Completed)
- Automatic Weapon Detection in Real-time Videos for Identification of Potential Terrorists and Robbers. The project has total approved fund of Rs 2.498 Million for duration of 2 years. (Completed)
- Development of an Automatic Number Plate Recognition (ANPR) system for car parks and vehicle access control using Computer Vision and Deep Learning. The project has total approved fund of Rs 0.6 Million for duration of 1 year. (Completed)

### Collaborations

- National Center for Robotics & Automation (NCRA), Islamabad
- College of EME, National University of Science and Technology, Islamabad
- Crescent Textile Mills Ltd
- Invictus Solutions (Pvt) Ltd

#### Dr. Muhammad Gufran Khan

Professor EE, is head of the AIMS Research Lab

### Sustainable Solutions Lab (SSL):

The Sustainability Solutions Lab (SSL) aims to provide students with an experience of professional development while working on sustainability-oriented research projects, especially related to Pakistan electrical power infrastructure.

In SSL students are working with faculty, staff, and field experts to define and solve some of our greatest challenges faces by the current electrical power infrastructure of Pakistan.

### Ongoing funded research project:

Designing of a reliable and resilient framework: A roadmap to next generation sustainable solutions for Pakistan electrical power infrastructure (0.9 million PKR).



### Main theme of the funded research project:

Due to Pakistan fragile electrical power infrastructure, any unexpected event, i.e., technical fault causes severe damage to power grids that can lead to a complete blackout. Therefore, designing a resilient and reliable power system network is an inevitable requirement for Pakistan electrical power infrastructure. This research project investigates the effect of these unexpected events on the power system network based on the recent blackout in Pakistan electrical power infrastructure. For example: A recent technical fault that occurred at the Guddu power plant triggered a sudden drop in the frequency of power systems that leads a chain reaction in the form of cascading failures and subsequently shut down various power plants in Pakistan electrical power infrastructure, choking about 10,320 megawatts of electricity. Considering this scenario, the major contribution of this research project will be designing a reliable and resilient power system that integrates phasor measurement units (PMUs) and distributed unified power flow controller to provide stability to the electrical power infrastructure of Pakistan in case of these unexpected events.

### Dr Muhammad Adnan

Assistant Professor (EE) Department of Electrical Engineering

### International Funded Projects:

#### In-Progress:

**Title:** Applications of Artificial Intelligence in Fault-Diagnosis and Fault-Tolerant Control for Industrial Applications

**Funding Agency Name:** Najran University, Electrical Engineering Department, Kingdom of Saudi Arabia

- Total Amount: 50,000 SAR, Start Date: January 2023, End Date: December 2023

#### Completed:

**Title:** Performance, Safety, and Reliability Enhancement of Industrial Applications using Advanced Control Systems Techniques

**Funding Agency Name:** Najran University, Electrical Engineering Department, Kingdom of Saudi Arabia

- Total Amount: 50,000 SAR, Start Date: February 2022, End Date: December 2022