MUHAMMAD UMAIR MUKATI

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RESEARCH INTEREST

Discipline: Computational Imaging
Focus area: Light Field Compression, Novel View Synthesis, Super-Resolution

PROFESSIONAL EXPERIENCE

RESEARCH:

Technical University of Denmark, Lyngby, Denmark Aug. 2018 - present

Ph.D. researcher at Coding & Visual Communication Group
Conducted research on light field coding and processing as an ESR in RealVision ITN project (H2020 MSCA), specially on the following lines:

- Efficient lossless light field compression scheme based on CALIC design.
- Deep-learning-based view synthesis to improve distributed light field coding.
- Convolutional Block Attention Module for light field view synthesis.

Istanbul Medipol University, Istanbul, Turkey Feb. 2015 - Aug. 2017

Research assistant at Computational Cameras & Vision lab.
Conducted research on the following lines:

- Super-resolution for micro-lens array based light field camera:
  - By combining captures from conventional photosensor and light field sensor.
  - By fusing multiple light fields sequentially captured after applying sub-pixel shifts using a mechanical translation stage.
- Synthetic enhancement of light field's aperture using structure from motion technique.
- Optical hardware to conduct experiments on Raytrix R10 camera for light field microscopy project.
- 3D point cloud generation to model building elevation using images captured by drone.

TEACHING:

PAF Karachi Institute of Economics & Technology
College of Engineering, Karachi, Pakistan Aug. 2017 - Jul. 2018

Lecturer in Electrical Engineering department and junior developer at Embedded Systems lab.

- Conducted lectures on Digital Image Processing and Digital Signal Processing.
- Supervised student projects related to image processing.
- Implemented face recognition system on FPGA.

PAF Karachi Institute of Economics & Technology
College of Engineering, Karachi, Pakistan Jan. 2014 - Jan. 2015

Lab engineer in Electrical Engineering department

- Conducted Linear Control Systems and Microprocessor & Microcontroller Based Systems labs.
- Developed hardware for Linear Control Systems lab.

EDUCATION

Doctor of Philosophy (PhD) Aug. 2018 - Jul. 2021 (Exp.)
Ph.D. Electronics and Communication
Department of Photonics Engineering
Technical University of Denmark
Thesis title: *Light field coding and processing for view sequences*

Masters of Science (MS) Feb. 2015 - Aug. 2017
M.S. Electrical-Electronics and Cyber Systems Engineering
School of Engineering and Natural Sciences
Istanbul Medipol University
Thesis title: *Extending Light Field Camera Capabilities*
CGPA: **3.73/4.00**

Bachelor of Engineering (BE) Jan. 2010 - Dec 2013
B.E. Industrial Electronics Engineering
Institute of Industrial Electronics Engineering
NED University of Engineering & Technology
Project title: *DSP based Software Defined Radio for FM Demodulation*
Percentage: **84.45 %**, CGPA: **3.70/4.00**

PUBLICATIONS

JOURNAL PUBLICATION

[1] M Umair Mukati and Søren Forchhammer. Epipolar Plane Image-based Lossless and Near-lossless Light Field Compression. *IEEE Access*, 2020.

[2] M Umair Mukati and Bahadir K Gunturk. Light field super resolution through controlled micro-shifts of light field sensor. *Signal Processing: Image Communication*, 67:71–78, 2018.

CONFERENCE PUBLICATION

[1] M Gul, M Umair Mukati, Michel Bätz, Søren Forchhammer, and Joachim Keinert. Light-field view synthesis using convolutional block attention module. In *arXiv preprint arXiv:2012.01900*, 2020.

[2] M. Umair Mukati and Søren Forchhammer. EPIC: Context Adaptive Lossless Light Field Compression using Epipolar Plane Images. In *2020 Data Compression Conference (DCC)*, pages 43–52. IEEE, 2020.

[3] M Umair Mukati and Bahadir K Gunturk. Light field registration: A multi-view geometry approach. In *2016 24th Signal Processing and Communication Application Conference (SIU)*, pages 1289–1292. IEEE, 2016.

[4] M Umair Mukati and Bahadir K Gunturk. Hybrid-sensor high-resolution light field imaging. In *2017 25th Signal Processing and Communications Applications Conference (SIU)*, pages 1–4. IEEE, 2017.

[5] M Umair Mukati, Milan Stepanov, Giuseppe Valenzise, Frédéric Dufaux, and Søren Forchhammer. View Synthesis-based Distributed Light Field Compression. In *2020 IEEE International Conference on Multimedia & Expo Workshops (ICMEW)*, pages 1–6. IEEE, 2020.

PROJECTS

VIEW SYNTHESIS-BASED DISTRIBUTED LF CODING

Employed distributed Source Coding (DSC) for light field images to extensively lift the computational requirement from the encoding side at the expense of increased computational complexity at the decoder side. The efficiency of DSC is heavily dependent on the quality of side information at the decoder. Therefore, we propose to leverage a learning-based scheme to generate side information.

EPIPOLAR PLANE IMAGE-BASED LOSSLESS/NEAR-LOSSLESS LF COMPRESSION

Developed an efficient lossless/near-lossless compression scheme for light field images by extending CALIC scheme and exploiting specifics of a dense light field structure.

LF SUPER-RESOLUTION THROUGH CONTROLLED MICRO-SHIFTS OF LF SENSOR

Developed a super-resolution approach for light field images, where multiple light fields are captured and fused to improve the spatial resolution. For each capture, the light field sensor is shifted by a pre-determined fraction of a micro-lens size using an xy translation stage.

SPATIALLY ENHANCED LF THROUGH HYBRID SENSING

Combined a light field sensor and a regular sensor with the help of beam-splitter to achieve spatially enhanced light field using homography and dense optical flow estimation for mapping pixels of high-resolution image to low-resolution perspectives of light field.

LF STITCHING FOR EXTENDED SYNTHETIC APERTURE

Developed synthetic aperture enhancement technique for micro-lens array based light field camera, by estimating 3D camera pose followed by merging of multiple projected light fields on a common plane. This resulted in improvement in light field capabilities, such as increased depth estimation range/accuracy and wider perspective shift range.

AUTOMATIC VEHICLE NAVIGATION

Implemented efficient lane detection algorithm using Hough transform over live-feed of camera for automatic vehicle navigation.

ONLINE COURSES

Deep Learning Specialization May 2019
Coursera, Stanford University, Andrew Ng, LINK

Robotics: Perception Apr. 2019
Coursera, University of Pennsylvania, Kostas Daniilidis, LINK

Machine Learning Feb. 2016
Coursera, Stanford University, Andrew Ng, LINK

Circuit & Electronics 6.002x Jun. 2012
EdX, MIT, Anant Agarwal, LINK

TECHNICAL STRENGTHS

Computer languages:	MATLAB, C/C++, Python, Visual C#, HTML, PHP
Softwares:	MATLAB, PyTorch, OpenCV, Eagle CAD, Adobe Photoshop
Embedded tools:	ARM microcontrollers, Raspberry PI, FPGA

REFERENCES

Prof. Søren Forchhammer Technical University of Denmark

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Ørsteds Plads, Building 343, Room 114,
2800 Kgs. Lyngby, Denmark
Email: **sofo@fotonik.dtu.dk**

Prof. Bahadir Gunturk Istanbul Medipol University

School of Engineering and Natural Sciences,
Kavacik Mah. Ekinciler Cad. No.19 Kavacik Kavsagi,
Beykoz Istanbul 34810, Turkey
Email: **bkgunturk@medipol.edu.tr**