Mohand Alzuhiri

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PROFESSIONAL SUMMARY

An algorithm engineer with a proven publication track record and industry experience. Expertise in designing and developing sensors and image processing algorithms for nondestructive evaluation and specializing in vision sensors and hybrid imaging methodologies for medical and NDE applications. Seeking to engage in cutting-edge projects and use my expertise to develop new imaging systems and algorithms.

WORK EXPERIENCE

- Software Engineer / Member of the technical staff, Jul 2022-Dec 2023, SAVTEQ.
- Graduate Research Assistant, Sep 2016 - Jul 2022, NDEL Group, Michigan State University.
- Graduate Research Assistant, Jan 2015 - Jul 2016, LEAP Group, University of Colorado.
- Optical and Microwave Transmission Engineer, Dec 2011- Mar 2014, Huawei Technologies.
- Technical Support Engineer, Aug 2011- Dec 2011, Earthlinktele for internet services.

EDUCATION

- Michigan State University, Michigan, USA — 2016-2022
  Ph.D. in Electrical Engineering
  GPA: 3.6/4
- University of Colorado Denver, Colorado, USA — 2014-2016
  M.S in Electrical Engineering
  GPA: 4/4
- University of Baghdad, Baghdad, Iraq — 2006-2011
  B.S in Electronics and Communications Engineering
  With High Honors (Ranked first)
  GPA: 78.8/100

SELECTED PROFESSIONAL PROJECTS

- Project TITAN (SAVTEQ): Design and implementation of an algorithm to reconstruct the stereoscopic image stream from a structured light based 3D inspection system. The algorithm includes object detection and tracking, finding the best images in focus, SL pattern segmentation and stripes subpixel peak localization, stereo matching, stereo camera calibration, and triangulation to 3D world (Tools: **Matlab** for algorithm development, **Bitbucket** for version control). The work also involved building a simulation model with **POV-Ray** to evaluate the 3D acquisition process with different imaged objects and environmental conditions.

- SFDI (SHS): Algorithm development for the reconstruction of the image stream from a spatial frequency domain imaging system (SFDI). The algorithm includes the separation of the AC and DC components and extraction of the absorption and scattering parameters with least square minimization. A lookup table based implementation was also developed for the purpose of real time reconstruction (Tools: **Matlab** for algorithm development**)**. The work also included conducting experimental work to validate the proposed concept and explore methods to improve the acquisition process (Devices: **QISDA IOS Gen2, TI DLP 3010 LC, and Allied vision Alvium camera**).

- ITPC phase IV DWDM backbone network (Huawei): Project planning and design review to ensure compliance with the existing customer (ITPC) network by reducing interference with existing working optical wavelengths, and avoiding mismatch with the existing communication boards and cabinets (software and hardware wise). Perform link budget calculations to ensure that the design matches the actual status of the existing links and recommend actions when needed. Perform site surveys to ensure the equipment can be accommodated in the installation sites (validate space and power requirements).

- ITPC phase III DWDM backbone network (Huawei): Equipment inspection upon delivery to ITPC storage sites, internal shipping and delivery to ITPC sites in the different provinces. Supervision of the equipment installation subcontractor teams. Deployment and integration with the existing ITPC network. Warranty support that included dealing with equipment failure, support ITPC in dealing with frequent optical cable accidents by helping them reduce network traffic congestion, and help the ITPC employees to manage the day to day network operations.

- ITPC phase II DWDM backbone network (Huawei): Customer support to manage the day to day network operations. Solve network congestion problems due to fiber lines damage. Handle optical signal degradation issues due to the deterioration of the fiber network by changing the link power budget, upgrading optical amplifiers, or fixing issues related to failing optical equipment. The role also included performing software upgrades on live network equipment, like communication boards or the network management system. Through this period I also supported the installation and deployment, and maintenance of microwave links and BSS sites for multiple customers like ITPC, Asiacell and Newroz telecom.

SELECTED RESEARCH PROJECTS:

- AI-enabled ILI robot with integrated structured light NDE for distribution pipelines (DOT-PHMSA): Design and fabrication of stereoscopic (Multiview geometry) RGBD endoscopic structured light sensor for integration with a robotic crawler associated with the 3D reconstruction algorithm. The work also included the development of an automatic calibration algorithm and a registration algorithm to reconstruct the pipe surface from consecutive 3D frames (Tools: **Eagle** for circuit design, **SolidWorks** for 3D sensor design, **Matlab** for 3D reconstruction and IMU calibration algorithms, **MatlabCoder** for Matlab-C code conversion, **Embedded C** for flash-Camera synchronization circuit control, **OpenCV** for camera calibration, and **Python** for camera control).

- A Novel Structured Light Based Sensing and Probabilistic Diagnostic Technique for Pipe Internal Corrosion Detection and Localization (DOT-PHMSA): Development of a new structured light sensor to exploit the sensor movement to improve the quality of the reconstructed 3D surface. The work involved system design and fabrication (Slide projector with MIPI cameras and Raspberry Pi), algorithm development, system geometric and radiometric calibration, and system fabrication and testing (Tools: **SolidWorks** for 3D sensor design, **Matlab** for 3D reconstruction algorithms, **Embedded C** for flash-Camera synchronization circuit control, **OpenCV** for camera calibration, and **C++** for camera control).

- Slow Crack Growth Evaluation of Vintage Polyethylene Pipes (GTI): Design of a multicolor multiring structured light sensor with automatic stabilization capability. The work also included integration with a robotic platform and adding RGB-D inspection capability to the structured light sensor (Tools: **SolidWorks** for 3D sensor design, **3D printing** for prototype fabrication, **Matlab** for 3D reconstruction algorithms, **Embedded C** for flash-Camera synchronization circuit control, **OpenCV** for camera calibration, and **Python** for camera control).

- Enhanced pulsed thermoacoustic imaging by noncoherent pulse compression (MSU): Development of a 2D thermoacoustic imaging system with coded pulse excitation to reduce the peak power required for the generation of the thermoacoustic signals. The work included system design and fabrication, design of an algorithm to decode the data, and data acquisition and reconstruction with time reversal (Tools: **COMSOL** for electromagnetic simulations, **Matlab** for 2D image reconstruction algorithms, **Python** for oscilloscope and stepper motor control).

- Evaluation of EM-based inspection methods for Butt fusion joints inspection (GTI): An investigative study to explore the suitability of the EM-based inspection methods to detect the existence of weak regions in the butt fusion joints. The NDE methods used are near-field microwave imaging, optical transmission scanning, and X-ray CT. (Tools: **COMSOL** for electromagnetic simulations, **Matlab** for image and statistical analysis, **Python** and **Embedded C** for stepper motor control (Arduino)).

Graduate Courses Topics

Machine vision, Neural networks, Probability and statistics, Image processing, Inverse problems, Signal processing, Wavelets, Random signal processing, Optimization, Electromagnetic circuit design, Antenna design, Numerical simulations methods, Clean room procedures, Academic writing.

JOURNAL PUBLICATIONS (Google scholar for full list of publications)

- **Alzuhiri**, M., Li, Z., Rao, A., Li, J., Fairchild, P., Tan, X., & Deng, Y. (2023). IMU-assisted robotic structured light sensing with featureless registration under uncertainties for pipeline inspection. NDT & E International, 102936.

- **M. Alzuhiri**, Z. Li, J. Li, A. Rao, and Y. Deng, “An Automatic Calibration Algorithm for Endoscopic Structured Light Sensors in Cylindrical Environment,” GNTE, 2023.

- **Alzuhiri, M**., Farrag, K., Lever, E., & Deng, Y. (2021). An Electronically Stabilized Multi-Color Multiring Structured Light Sensor for Gas Pipelines Internal Surface Inspection. IEEE Sensors Journal.

- **Alzuhiri, M**., Song, J., Li, B., Kumar, D., Qiu, Z., Qian, J., & Deng, Y. (2021). Enhanced pulsed thermoacoustic imaging by noncoherent pulse compression. Journal of Applied Physics, 130(17), 174902.

- S. Mukherjee, R. Zhang, **M. Alzuhiri**, V. Rao, L. Udpa, and Y. Deng, “Inline Pipeline Inspection using Hybrid Deep Learning Aided Endoscopic Laser Profiling,” Journal of Nondestructive Evaluation (Springer), 2022.

CONFERENCE PUBLICATIONS

- **M. Alzuhiri**, R. Rathnakumar, Y. Liu, and Y. Deng, “A novel structured light based sensing and probabilistic diagnostic technique for pipe internal corrosion detection and localization,” in PHMSA R&D Forum, 2020.

- **M. Alzuhiri**, L. Zonglin, and Y. Deng, “A phase measurement based structured light sensor for the inspection of internal corrosion of metal pipes,” in *ENDE*, 2019.

- **M. Alzuhiri** and Y. Deng, "Motion based structured light sensor for 3D profiling of internal defects in small diameter plastic gas pipelines," SPE-ACCE, 2018.

- **M. Alzuhiri** and Y. Deng, “Structured light-based endoscopic scanner for small diameter gas pipelines,” in *ENDE*, 2017.

- **M. Alzuhiri**, Y. Deng, M. Golkowski and R. Jacob, "Numerical model for microwave induced thermoacoustic imaging," in *Radio Science Meeting (USNC-URSI NRSM)*, Boulder, Colorado, USA, 2016.

COMPUTER SKILLS

- Programming Languages: MATLAB, Python, Embedded C, and C++.
- Vision frameworks: Matlab vision and image processing toolboxes and OpenCV.
- Machine learning frameworks: Keras, Matconvnet, and Matlab machine learning toolbox.
- Embedded systems: StereoPi, Raspberry Pi, and Arduino.
- Engineering Programs: COMSOL, CST, ADS, Multisim, Eagle, and SOLIDWORKS.
- Communication systems: Huawei RTN, NEC microwave, Huawei SDH, Huawei DWDM, Huawei U2000.
- Operating Systems: Microsoft Windows and Linux.

LANGUAGE SKILLS

- English: Fluent
- Arabic: Native

References:

[1] Dr. Yiming Deng, Professor, Michigan State University, dengyimi@egr.msu.edu.

[2] Matt Bellis, Chief Executive officer, Seikowave Health Solutions, mbellis@seikowave.com.

[3] Eli Crane, Electrical Engineering Director, Seikowave Health Solutions, ecrane@seikowave.com.