FRED LIVINGSTON, PHD
PRINCIPLE ROBOTICS ENGINEER
ADJUNCT ASSISTANT PROFESSOR
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EDUCATION

Ph.D. North Carolina State University, Raleigh
Electrical and Computer Engineering (2014)

MS. North Carolina State University, Raleigh
Electrical and Computer Engineering (2006)

BS. North Carolina State University, Raleigh
Electrical and Computer Engineering (2003)

INTEREST

My research involves the advancement of cyber-physical systems for autonomy and advanced manufacturing. These systems utilized multi-agent robotics technologies, decentralized control, sensor fusion, optimal motion planning, edge-computing, reinforcement learning, blockchain, smart contracts, and security. I firmly believe the key to success is physically and mentally pushing boundaries. When not in the office or co-working space, you can find me competing in challenges such as Badwater Ultra, IRONMAN, and Spartan.

PROFESSIONAL EXPERIENCES

SECMATION, Raleigh NC

- **Principle Robotics Engineer [2021 - present**] Real-time control architectures for rapidly developing secured unmanned systems. Research topics include:
  - Secured architecture for rapid deployment of ROS-M, ROS2, and MATLAB algorithms to unmanned vehicles
  - Multi-rotor control algorithms for an autonomy research arena
  - Project manager and point of contact for Phase 2 SBIR with the Office of Naval Research (ONR). Code 351 Air Warfare and Weapons
  - Manage summer internship program

MECHASPIN, Lake Mary FL

- **Sr. Robotics Engineer [2018 - 2021**] Research and develop perception and control algorithms for large-scale robotics systems. Contributions include:
  - 3D LiDAR system integrations (Velodyne, Ouster, Quanergy)
  - Deep Learning algorithms for real-time object detections and tracking using 3D point clouds
  - Kinematics and dynamic modeling of robotic manipulators.
  - Robotic simulation using ROS/Gazebo and Unreal gaming engine.
  - NVIDIA GPU enhances edge device processing (Jetson Nano, Xavier)
  - Project sponsor by ONR, Code 33 Advance Naval Platforms

NORTH CAROLINA STATE UNIVERSITY, Dept. of Electrical and Computer Engineering, Raleigh NC

- **Adjunct Assistant Professor [Spring 2022]** graduate course for 'Computer Control of Robotic Systems' Topics includes: 3D Motion Planning, Feedback control, and Robot Simulation and programming.

- **Adjunct Assistant Professor [Spring 2015, 2019]** Senior-level undergraduate course 'Robotic Systems' Topics include mathematical modeling and simulation of industrial planar robots, forward and inverse kinematics, velocities, and trajectory. This course was also taught remotely to UNC Asheville through the distance education program.

DUKE UNIVERSITY, Pratt School of Engineering, Durham NC

- **Adjunct Assistant Professor [Fall 2019]** Course instructor for ME-555-06. In this course, the students are taught the principles of the design and control of robotic systems. Topics include kinematics, dynamics, control, and robot simulation. In addition to core objectives, this course includes hands-on activities and group learning.

ECPI University, College of Technology, Raleigh NC

- **In-seat and Online Faculty [2016 - 2017]** Faculty member in the Electronics Engineering Technology curriculum. My teaching responsibility included the following courses.

Courses		Course Overview
C Programming 1	CIS126	This course introduces the C programming language using the Microsoft Visual Studio Environment. Topics included Control structures and Functions, Arrays and Pointers, Strings and Characters, Structures and Unions
Industrial Applications	EET220	This course covers the basic principles of Silicon-controlled rectifiers and motor control circuits. Students learned about process control system concepts and various sensor technologies.
Microcontrollers	EET430	This course covers the fundamental principles of Microcontroller technologies. Students were introduced to HCS12 Microcontrollers and embedded systems. Topics covered include architecture, memory map, I/O interfacing, and interrupts. Application projects are an integral part of the course requiring programming and interfacing with electronic circuits.
Programmable Controllers and Robotics	EET331	This course covers advanced principles of control systems. Students were introduced to industrial control and statistical process control concepts. Sensor applications and Hands-on applications in programming and troubleshooting Programmable Logic Controllers are emphasized.
Circuit Analysis	EET310	This course covers network theorems. Students learned about electrical circuit analysis using circuit theorems; node-voltage, mesh current, Thevenin and Norton theorems. Students were introduced to dependent source models. Transient and steady-state circuit analyses are covered.
Instrumentation and Measurement Lab	EET221L	This course concentrates on electronics instrumentation and measurement tools. Topics covered include errors, sensors and transducers, and signal conditioning. An extensive hands-on laboratory experience introduced the students to different electrical and electronic measuring devices set up and used for component and board level troubleshooting and repair.

OLAERIS, Raleigh NC

- **R&D Engineer [2016 – 2018]** Developing large-scale unmanned aerial systems designed specifically for domestic emergency services.
    - Electrical and firmware design of power management system for large-scale UAS platform: Analog and digital prototyping and design real-time current, temperature, and voltage using ATMEGA processor and custom PCB.
    - Development of wireless communication system and algorithm for beyond line of sight navigation and control using C++ and ROS
    - Algorithm for self-docking and charging
    - Project management of capstone projects with the University of North Carolina State and North Carolina Agricultural and Technical State University
    - Head of the flight operation for unmanned system

NextGen Air Transportation, Raleigh NC

- **Post-Doctoral Fellow [2014 - 2015]** Investigation of the use of Unmanned Aerial System for NC Department of Transportation). Contributions include:
    - Non-metric camera photogrammetry survey in challenging terrains.
    - UAS flight planning using GIS tools such as GRASS, Google Earth, ArcMap
    - Command and control of UAS in GPS-denied environments
    - Investigation of human-assisted flight control of unknown domains using Parallel Tracking and Mapping (PTAM) implemented on the Robot Operating System (ROS)
    - 3D Model reconstruction from aerial imagery using Structure for Motion (STM)
    - Best practices for integration with manned and unmanned airspace

Graduate Student - Center for Robotics and Intelligent Machines [2003 - 2014] North Carolina State University

Developed a colony of unmanned autonomous vehicles for environmental monitoring. The project involved the fusion of sensor data from multiple robots to complete a common task. Responsibilities included:

- Hardware, mechanical, and electrical design of wireless sensors.
- Developing control algorithms for autonomous navigation.

Development of a Human-Machine Interface for prosthetic limb control; this research involves biomedical instrumentation, machine learning [neural networks], mechatronics, and control theory.

Sandia National Laboratories, Albuquerque NM

- **Mechanical Engineer, Graduate Intern [2004, 2006]**
    - Finite Element Analysis (FEA) of raw materials for laser forming
    - Designed, assembled, and tested a mesoscopic-scale radio frequency switch using advanced CAD tools, modeling techniques, Labview, robotic manipulators, and advanced vision systems.

PROFESSIONAL ORGANIZATIONS

- IEEE Senior Member (In-Process 2022)
- IEEE Eastern North Carolina Robotics & Automation Society Chapter President
- Association for Unmanned Vehicle Systems International (AUSVI) – Member
- IEEE Sensor Council, Social Media Chair (2015)
- IEEE International Conference on Intelligent Robots and System (IROS) Web Administrator (2007)

RELEVANT INVENTION DISCLOSURES AND PATENTS

- The Binary Encoding of Sensors in 2D and 3D Knitted Structures (2019)
- Wireless Communication between an operator of a Remotely Operated Aircraft and a Controlling Entity (2019)
- A Wireless Ultrasound System with a Controllable Beam (2010)
- Health Monitoring and Management Systems (2008)

PRODUCT DEVELOPMENT

- **Flexcell FX5000** (2006)
  The FX5000 is a biomedical tissue engineering product developed through my master's dissertation. This pneumatic cell stretching bioreactors system uses vacuum pressure to enhance your ability to research cellular mechanics by creating in vitro models and 3D tissue constructs within the most optimal simulated in vivo environment for cell proliferation and growth.

- **Carolon's SmartSleeve** (2014)
  SmartSleeve integrates engineering into textiles to treat vascular disorders by sensing and adjusting the compression to a wound. This patent technology was made commercially available by the Carolon Company.

CERTIFICATIONS

- USF Certification in Grant Writing (Schedule Summer 2022)
- Deep Learning for Robotics - NVIDIA (2020)
- ED101 Effective Teaching Strategies – Center for Excellence in Education (2017)
- ED102 Student Retention Methods – Center for Excellence in Education (2017)
- ED109 Preparing and Creating Lesson Plans – Center for Excellence in Education (2017)

HONORS AND AWARDS

- Emerald LiteratiNetwork Outstanding Paper Award (2007)
- Microsystems and Engineering Sciences Applications (MESA) Institute Fellow (2004, 2006)

MENTORING

- Independent Study (Present) – Reinforcement learning for low-cost bipedal robots
- Mechanical Engineering Senior Design Project (2022) – Assist a senior design team in the design and control of a legged robot for the exploration of unknown terrain.
- Wake Forest Senior Design Projects (2021) – Integration of 3D LiDAR into a multirotor for vegetation surveys

PUBLICATIONS

[1] H. Aldridge and F. Livingston, "Secure Rapid Prototyping for Unmanned Systems," in *NDIA Ground Vehicle Systems Engineering and Technology Symposium*, Novi, Michigan, 2021.

[2] F. Livingston, E. Grant, and G. Lee, "On the Design of a KANSEI Robot Testbed for Understanding Human Machine Interaction," in *International Conference on KANSEI Engineering and Emotion Research*, Paris, France, 2010.

[3] F. L. M. C. M. H.-C. S. M. Edward Grant, "Characterizing conductive yarns for pressure sensors applications," in *IEEE SENSOR*, 2015.

[4] F. J. Livingston, "Technology for Improving the Quality of Life for Patients Suffering from Vascular Insufficiency," North Carolina State University, Raleigh, 2014.

[5] F. J. Livingston, "Development of an Internet Addressable Pneumatically Controlled Instrument for Applying Stain the Cells In-Vitro," North Carolina State University, Raleigh, 2006.

[6] J. A. Palmer, B. Jokiel, C. D. Nordquist, B. A. Kast, C. J. Atwood, F. J. Livingston, E. Grant, F. R. Medina, and R. B. Wicker, "Mesoscale RF relay enabled by integrated rapid manufacturing," *Rapid Prototyping Journal,* vol. 12, no. 3, 2006.

[7] M. Hegarty, F. J. Livingston, E. Grant and L. Reid, *A Wearable Monitoring System for Continuously Assessing the Health of the Peripheral Vasculature.*

[8] F. J. Livingston, "Implementation of Breiman's random forest machine learning algorithm," North Carolina State University, 2005.

PUBLICATIONS IN PREPARATION

[9] F. J. Livingston and E. Grant, "A Design and Modeling Software Tool for Prototyping Ultrasound Transceivers," *IEEE Sensors Journal.*

[10] F. J. Livingston and E. Grant, "Wireless, Wearable, and Real-Time Vasculatory Signal Processing and Diagnostics," *IEEE Engineering in Medicine and Biology Society.*

[11] F. J. Livingston, E. Grant, and M. Hegarty-Craver, "A Wearable System that Monitors and Adaptively Controls Compression to Patients Suffering from Vascular Insufficiency," *IEEE/ASME Trans on Mechatronics.*

[12] F. J. Livingston and E. Grant, "The Design and Development of an Ambulatory Wireless Broadband Ultrasound Transceiver," *IEEE Sensors Journal.*

REFERENCES

- Prof. Edward Grant (email: egrant@ncsu.edu)
  Department of Electrical and Computer Engineering, NCSU
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