Exponent®
Engineering & Scientific Consulting

Florin Marcu, Ph.D., P.E.

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Professional Profile

Dr. Marcu is a mechanical engineer with deep industry experience in product development, research, and validation in the areas of earth-moving equipment and heavy trucks. He has extensive experience in dynamics, vibration, human factors, operator visibility, and noise with a particular focus on evaluating and mitigating the effect of vibrations on vehicle occupants through proper selection and design of the vehicle chassis, cabin, and seat suspensions.

Dr. Marcu leverages his industry and educational experience to investigate failures in all types of complex mechanical systems and equipment – from vehicles and mobile equipment to industrial production systems, commercial and residential building mechanical equipment, and consumer products.

Dr. Marcu's work has included support for litigation, insurance, risk management and proactive projects and he has conducted inspections for injury, property damage, lemon law, and construction defect cases.

Dr. Marcu has conducted testing both in a lab and in the field with the purpose of evaluating occupant comfort, health and safety, component performance and durability, and vehicle dynamics. He has led vehicle noise mitigation projects and has experience improving the quality of audible alerts in vehicles.

Dr. Marcu's expertise includes:

Vehicles and Equipment:

- Construction, mining, and earth-moving equipment
- On and off-highway trucks
- Automotive
- Building mechanical systems including HVAC, plumbing and fire suppression systems

Vibration and Noise:

- Vibration and its effect on structures, occupants, and equipment performance
- Seats and seat belts
- Passive and active suspension systems
- Vehicle noise (interior and exterior)

Testing:

- Objective and subjective lab and field testing
- Shake and vibration table testing for durability and performance, including human vibration testing
- Immersive, interactive vehicle simulators and motion/simulator sickness
- Sensor selection and data acquisition
- Pressure testing
- Fixture design

Data Analysis:

- Noise and vibration data analysis
- Digital signal processing in both time and frequency domain
- Fatigue damage spectrum analysis

Before joining Exponent, Dr. Marcu led Kenworth Trucks' noise and vibration work. This followed 9 years at Caterpillar where he led the ride simulator laboratory and conducted research on human vibration, semiactive seat and cabin suspensions using a human-rated, 6-degree-of-freedom shake table.

Dr. Marcu's mechanical engineering experience has consistently straddled the divide between theory and hands-on application. This started during his doctoral work at Virginia Tech, where he developed a dynamic model of a semitruck from first principles which he used to design a semiactive cab suspension and its control algorithm. He then modified a semi truck, installed the new cab suspension, implemented the real-time controller, and conducted all the lab and field tuning of the system. His dissertation work culminated in the delivery of a truck with a working prototype of a novel, semiactive cab suspension.

While completing the Ph.D. work, Dr. Marcu built up a machine shop and developed the IT infrastructure in the research lab. He also performed maintenance on the facility’s IT and lab equipment.

During his undergraduate years, he was an active leader and member of the Tennessee Tech Baja SAE team (then Mini Baja). Post graduation he was involved in the organization, racecourse design, and design judging at several Baja SAE races.

Dr. Marcu served in the Swedish Air Force where he performed turnaround crew work on the Saab J-35 Draken jet fighter, facility maintenance, and fire fighter duties. As part of his military training, he received and maintained a Commercial Driver’s License in Sweden from 1998-2020.

Academic Credentials & Professional Honors

Ph.D., Mechanical Engineering, Virginia Polytechnic Institute and State Univ, 2009

B.S., Mechanical Engineering, Tennessee Tech University, 2005

Pi Tau Sigma, Honors Society for Mechanical Engineers

Tau Beta Pi, Engineering Honors Society

Omicron Delta Kappa, National Leadership Honor Society

Licenses and Certifications

Professional Engineer Mechanical, Washington, #24004709

Six Sigma Green Belt Certification (CSSGB)

Certified Fire and Explosion Investigator (CFEI)

Academic Appointments

Graduate Research Assistant, Center for Vehicle Systems & Safety, Virginia Tech, 2005-2009

Graduate Teaching Assistant, Land Vehicle Dynamics, Virginia Tech, 2006-2009

Prior Experience

Lead NVH Engineer, Kenworth Trucks, 2018-2021

Vibration Engineering Specialist, Caterpillar, Inc., 2015-2018

Seat Suspension Sr. Engineer, Caterpillar, Inc., 2012-2015

Cab Suspension Engineer, Caterpillar, Inc., 2009-2012

Wave Soldering Line Engineer, Denso Manufacturing, 2003-2004

Turn-around mechanic (rank: staff sergeant), Saab J-35 Draken (jet fighter), Swedish Air Force, 1998

Professional Affiliations

Society of Automotive Engineers (SAE)

The American Society of Mechanical Engineers (ASME)

Languages

German

Swedish

Romanian

Patents

US Patent 8,682,528: Seat suspension system having fail-safe functionality, March, 2014 (Michael S. Contratto, John C. Spangler, JR., II Charles E. Lewis, Florin M. Marcu, Kristen A. Gerstner).

Publications

Farjoud, A., Marcu, F., and Schumann, E., "Multi-Physics Modeling of a Cab Suspension System with Fluid Filled Mounts," SAE Technical Paper 2012-01-1912, 2012

Marcu, F., Ahmadian, M., Southward, S., and Jansson, S., "A Methodology for Laboratory Testing of Truck Cab Suspensions," SAE Technical Paper 2009-01-2862, 2009

Marcu, F., Ahmadian, M., Southward, S., and Jansson, S., "A Methodology for Accounting for Uneven Ride Height in Soft Suspensions with Large Lateral Separation," SAE Technical Paper 2009-01-2920, 2009

Project Experience

Exponent Projects

Vibration and Noise:

- Investigated vibration-related lemon law claims in trucks.
- Developed Python code to perform Fatigue Damage Spectrum analysis.
- Developed Python code to analyze vibration data.
- Investigated vibrations in vertical pump systems.
- Testing and analysis of product damage in transport.

Mechanical Failures:

- Conducted analysis of Diesel Rotary UPS failures and maintenance.
- Investigated diesel generator fires.
- Investigated residential pipe coupling failures.

HVAC and Plumbing:

- Built and operated a 10ksi hydrostatic pressure test system.
- Investigated numerous commercial and residential sprinkler pipe freeze failures.
- Conducted HVAC analysis of a large condominium tower VRF heat pump system with 20 condensers and numerous fan coil units.
- Conducted HVAC system noise analysis.
- Conducted HVAC analysis of a residential mini-split heat pump system with multiple air cleaner systems.
- Performed pipe flow calculations in a residential hydronic heating system.

Accidents, Safety and Health:

- Root cause analysis of personal injury cases involving vehicles, industrial equipment, and furniture.
- Analyzed automotive brake system and its influence in multi-vehicle accident.
- Analyzed of underground mining belt failure.
- Analyzed of automatic door opener system.
- Investigated carbon monoxide poisoning cases.
- Conducted root cause investigation of commercial and residential fire scenes.

Projects from past employers

- Identified sound quality issues and improved digital display chime audibility through changes to the sound amplifier circuit.
- Developed corporate strategy for noise and vibration performance for OEM vehicle platforms.

- Created FEA models and conducted structural analysis of engine- and chassis-mounted components.
- Conducted field investigations for cabin noise level and interior sound quality at customer sites.
- Collected vibration data and performed Operational Deflection Shapes (ODS) and Transfer Path Analysis (TPA).
- Performed human vibration, visibility, ergonomics and usability studies on a human-rated shake table.
- Performed air borne and structure borne noise testing both in lab and in the field.
- Collected rigid body vibration data from field equipment and converted it into 6DOF laboratory shake data.
- Developed passive and semiactive seat suspension systems for off-highway equipment.
- Developed semiactive cab suspension for on and off-highway equipment.
- Developed control algorithms for suspension systems for on and off-highway vehicles.
- Led and operated several research labs and machine shops with a perfect safety record.

Additional Education & Training

Automate the Boring Stuff with Python, Online Course, 2021

Machine Learning, Stanford University, 2020

MSHA Part 48A&B Coal/Metal/Nonmetal Surface & Underground Safety Training, 2011-2018

Advisory Appointments

ISO TC108/SC4 Human exposure to mechanical vibration and shock

ISO TC127/SC2 US TAG Earth Moving Machinery

SAE HFTC4 Operator Seating and Ride

Peer Reviews

Society of Automotive Engineers

Journal of Failure Analysis and Prevention