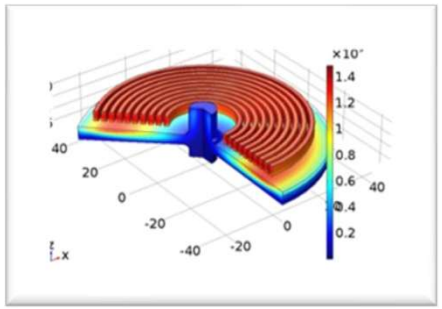
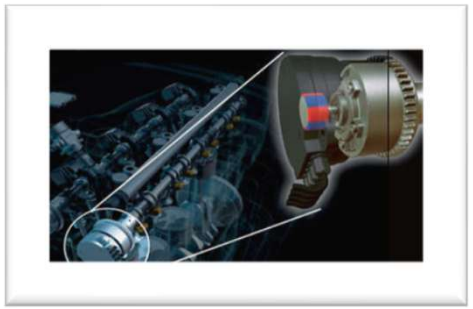
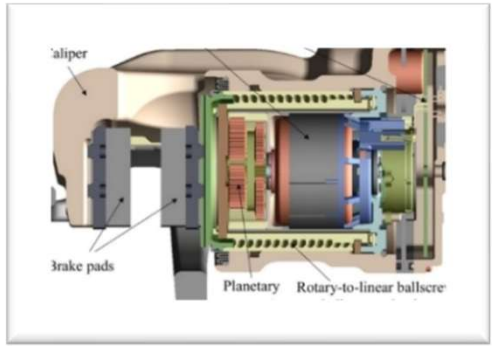
Hybrid utility truck
Source: eaton.com



Thompson-coil circuit breaker
Source: IEEE ECCE 2015



Electric cam phaser
Source: Delphi (IEEE MTZ Zeitschtrift, 2012)



Electric brake
Source: Delphi (IEEE IAS Mag, 2009)

Bruno Lequesne, PhD, Fellow IEEE

E-Motors Consulting, LLC

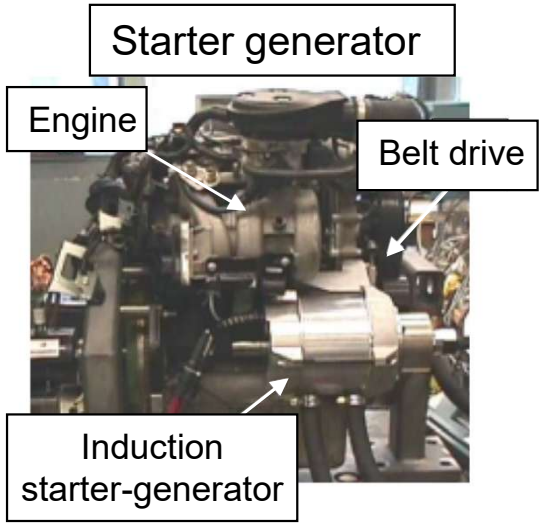
www.emotorseng.com

Employment history

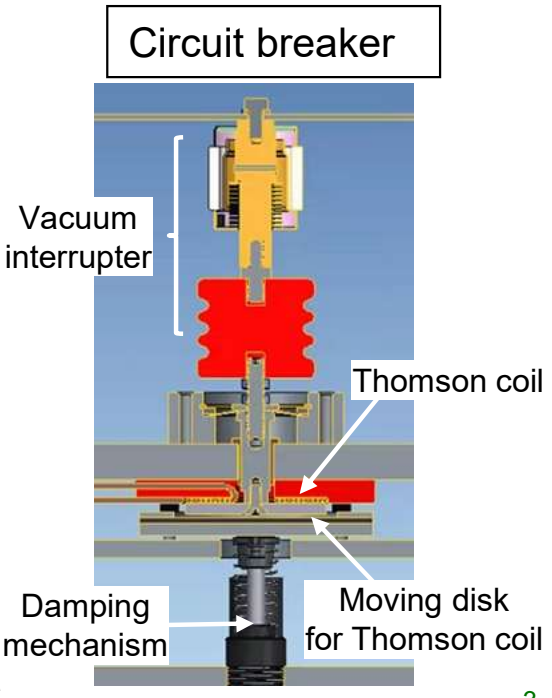
- 40+ years in automotive electrification and advanced engineering
- Independent consultant (E-Motors Consulting, LLC): 2014
- Eaton: 2010-2014
- University of Alabama: 2009-2010
- Delphi Research, Delphi Advanced Powertrain Group: 1999-2009
- General Motors Research Labs: 1984-1999
- Chair, IEEE Transportation Electrification Community (2019-2020)
- President, IEEE- Industry Applications Society: 2011-2012
- Education, Electrical Engineering:
  - Missouri University of Science and Technology, PhD, 1984
  - Ecole Supérieure d'Electricité, France, 1978

Expertise: Electric drives and electromagnetism

- Electric machine design
  - Permanent magnet and induction motors (as a consultant)
  - Permanent magnet motors (e.g, for valve actuation, while at GM)
  - Induction motor (e.g., starter-generator, at GM, Delphi)
  - Switched reluctance motor controls (e.g., for brakes, at Delphi)
- Linear actuators
  - Circuit breaker actuator (as a consultant)
  - Linear motors, oscillatory actuators (e.g., valve actuators, at GM)
  - Control solenoids (e.g., fuel injectors, at GM)
- Sensor concepts
  - Position, based on Hall effect or variable reluctance (e.g., ABS, engine position, steering, at GM and Delphi)
  - Torque (e.g., for electric power steering, at Delphi)
  - Force, pressure, based on magnetostriction (e.g., for brakes, engine pressure, at Delphi)
- Electromagnetic simulation



Source: IEEE TIA, 2002



Source: IEEE TIA, 2023

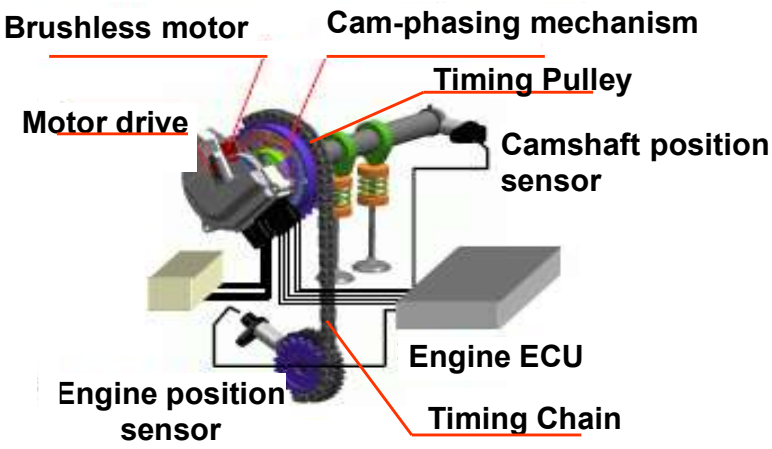
Expertise: Systems

- Transportation electrification
- Hybrid-electric and full-electric powertrains
  - Powertrain motors (as a consultant)
  - Starter-generators (while at GM, Delphi)
  - Commercial vehicles (while at Eaton)
  - Hybrid configurations (now at E-Motors)
- Electro-mechanical systems
  - For example, valvetrains: How to best electrify valve trains, from cam phasers to fully variable valve actuation (while at Delphi)

Hybrid utility truck

Source: eaton.com

Engine cam phaser system



Source: denso.com

Expertise: Management

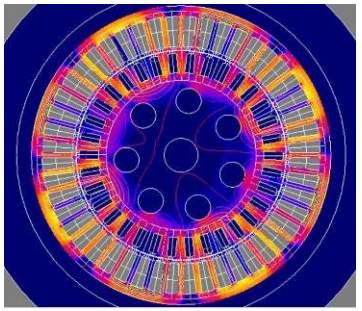
- Chair, IEEE Transportation Electrification Community (2019-2020)
  - Volunteer position
  - The Transportation Electrification Community is tasked with coordinating all activities within IEEE concerning this technical field
- President, IEEE Industry Applications Society (2011-2012)
  - Volunteer position (supported by employer)
  - Technical engineering society; 11,000 members, $3M budget
  - During tenure (2011-2012):
    - Oversaw creation of 3 technical committees (+10%)
    - Creation of 3 new journals
- Delphi Advanced Powertrain (2006-2009)
  - Group manager for development of new concepts in valvetrains, sensors, and fuel systems
- Project management throughout career

Expert witness experience

- Supported 8 cases to date
- 6 related to patent litigation
- 1 about a warranty dispute
- 1 accident related

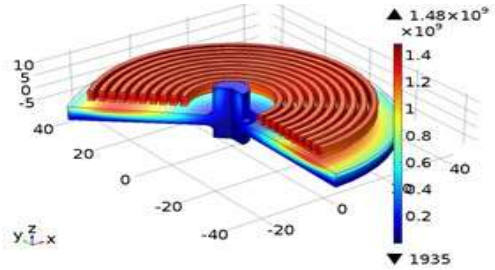
Recent projects (E-Motors Consulting)

- Automotive systems:
  - Motor designs for a Tier 1 automotive supplier
  - Evaluation of electrical drive systems for hybrid applications
  - Role of magnetic hysteresis in actuator performance
- Aerospace:
  - Electric machine design for pump application
- Renewable energy:
  - Support of a start-up working on small hydro generation (under Dept. of Energy grants)
- Actuators:
  - Fast electromagnetic actuation for DC circuit breaker
- Expert witness with trial experience



Induction motor (400 Hz)

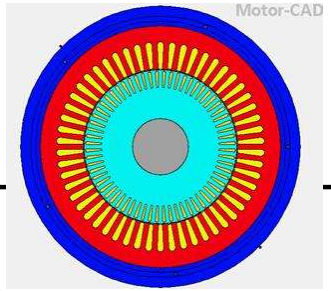
Prototype turbine for small hydro (with Cadens, LLC)



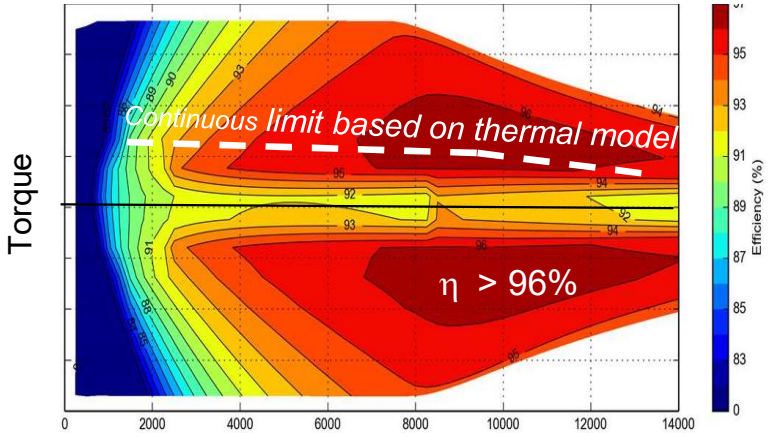
Thompson coil actuator (Trans. on Industry Appl., 2016, 2022)

Modeling tools

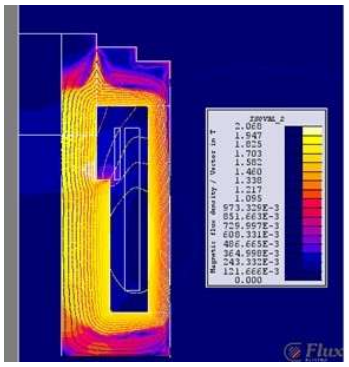
- Motor modeling: MotorCAD
  - Permanent magnet and induction
  - Electromagnetic and thermal models
  - Based on both closed form and finite element



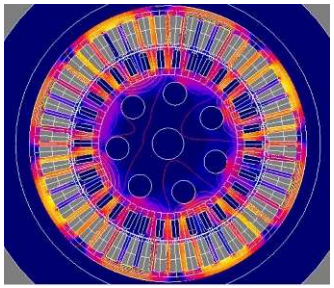
Traction motor



- Finite element: Flux from Altair



Linear solenoid actuator



Aerospace motor

Awards

- IEEE Tesla award, 2016
  - “For contributions to the design and analysis of actuators, sensors, and motors for automotive applications”
- IEEE Fellow, 1997
  - "For contributions to the development of electromechanical actuators for automotive applications".

Source: ieee.org

- IEEE Industry Applications Society, Gerald Kliman Innovator Award, 2007
- Best Paper awards:
  - IEEE Industry Applications Society, Second Prize Transactions Paper Award, 2016
  - IEEE Industry Applications Society, Second Prize Transactions Paper Award, 1996
  - IEEE Industry Applications Society, Electric Machines Committee, Best Paper Awards: 6 awards, 1987-2005
  - Society of Automotive Engineers:
    - SAE Vincent Bendix Automotive Electronics Engineering Award, 2006
    - SAE Arch T. Colwell Award, 2000
    - Excellence in Oral Presentation, 1998

Publications

Complete list in resume

- Patents: 56

- Papers (recent)
  - "Frequency-domain analysis and design of Thomson-coil actuators," B. Lequesne, T. Holp, S. Schmalz, M. Slepian, H. Wang, IEEE Trans. on IA, vol. 59, no. 2, March/April 2023
  - “Low-cost interior permanent magnet machine with multiple magnet types,” Q. Ma, A. EL-Refaie, B. Lequesne, IEEE Trans. on IA, vol. 56, no. 2, March/April 2020
  - “Active damping of ultra-fast mechanical switches for hybrid AC and DC circuit breakers”, C. Peng, L. Mackey, I. Husain, A. Huang. W. Yu, B. Lequesne, R. Briggs, IEEE Trans. on IA, Vol. 53, No. 6, Nov./Dec. 2017

- Presentations (recent)
  - 10-29-2019 – Colloquium, Marquette University - Topic: Electric machines for automotive propulsion: History and future.
  - 05-09-2019 – Invited keynote speaker, International Transportation Electrification Conference Asia Pacific (ITEC-AP), Jeju Island, Korea – Topic: Electric machines for automotive propulsion: History and future.

Summary

- Seasoned researcher, inventor, engineer and manager in the field of electric drives, actuators, sensors and electro-mechanical systems

- Expert in automotive and transportation electrification
  - Including expert witness with court experience

- Consulting on:
  - Intellectual property analysis and strategy, expert witness
  - Technology roadmapping and strategizing, discerning new trends
  - Development of new concepts and products