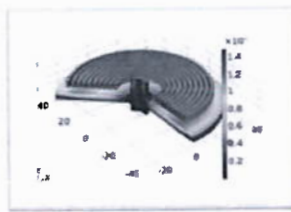




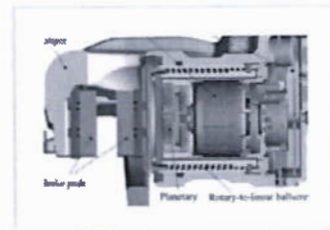
Hybrid utility truck
Source: *eaton.com*



Thompson-coil circuit breaker
Source: *IEEE ECCE 2015*



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

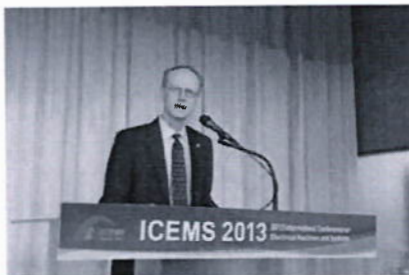


Electric brake
Source: *Delphi (IEEE IAS Mag, 2009)*

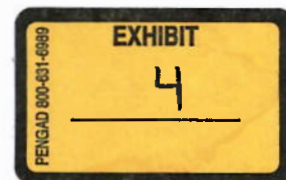
Bruno Lequesne, PhD, Fellow IEEE

E-Motors Consulting, LLC

www.emotorseng.com



Bruno Lequesne, E-Motors Consulting, LLC



Employment history

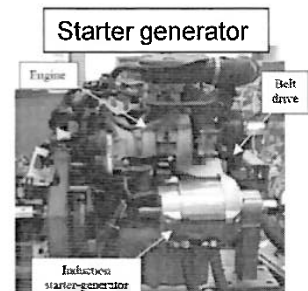
- 40+ years in automotive research and advanced engineering
- Independent consultant (E-Motors Consulting, LLC): 2014
- Eaton: 2010-2014
- University of Alabama: 2009-2010
- Delphi Research, Delphi Advanced Powertrain Group: 1999-2009
- General Motors Research Labs: 1984-1999
- Chair, IEEE Transportation 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



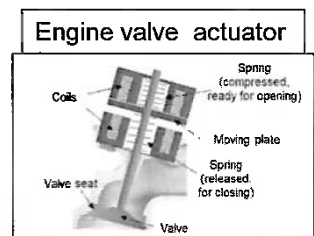
Bruno Lequesne, E-Motors Consulting, LLC

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
 - 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

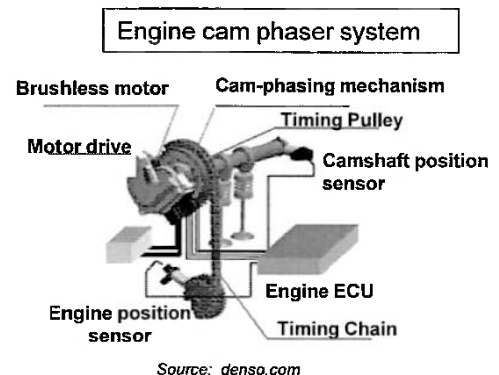


Bruno Lequesne, E-Motors Consulting, LLC

3

Expertise: Systems

- Electro-mechanical systems
 - For example, valvetrains: How to best electrify valve trains, from cam phasers to fully variable valve actuation (while at Delphi)
- Transportation electrification
- Hybrid systems
 - Starter-generators (while at GM, Delphi)
 - Commercial vehicles (while at Eaton)
 - Hybrid configurations (now at E-Motors)
- Micro-hybrid power generation



Bruno Lequesne, E-Motors Consulting, LLC

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



Bruno Lequesne, E-Motors Consulting, LLC

5

Expert witness experience

- Crandall Technologies LLC v. Greatcall, Inc., infringement case, 2019
- MPC Inc. v. Standex Electronics Inc., warranty dispute between two automotive suppliers, 2019
- Patent litigation case concerning electric motors for automotive applications, 2018
- AM General, LLC v. UUSI, LLC, 4 IPR cases, with deposition, 2016-2017
- SD3 LLC v. US PTO, with deposition and testimony at trial (US District Court), 2016

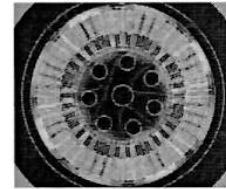


Bruno Lequesne, E-Motors Consulting, LLC

6

Recent projects (E-Motors Consulting)

- Automotive systems:
 - Evaluation of electrical drive systems for hybrid applications
 - Motor designs for a Tier 1 automotive supplier
 - Role of magnetic hysteresis in actuator performance



Induction motor (400 Hz)

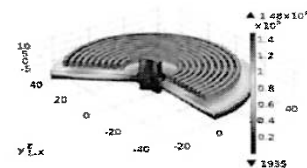
- Aerospace:
 - Electric machine design for pump application



Prototype turbine for small hydro
(with Cadens, LLC)

- Renewable energy:
 - Project manager for a start-up working on small hydro generation (under Dept. of Energy grant)

- Actuators:
 - Fast electromagnetic actuation for DC circuit breaker



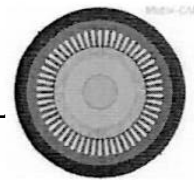
Thompson coil actuator
(Trans. on Industry Appl.,
2016)



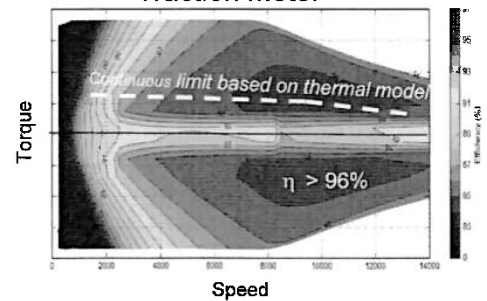
Bruno Lequesne, E-Motors Consulting, LLC

Modeling tools

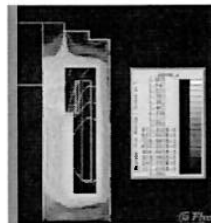
- Motor modeling: MotorCAD
 - Permanent magnet and induction
 - Electromagnetic and thermal models
 - Based on both closed form and finite element



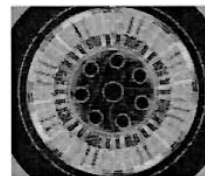
Traction motor



- Finite element: Flux from Altair



Linear solenoid actuator



Aerospace motor



Bruno Lequesne, E-Motors Consulting, LLC

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".
- 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



Bruno Lequesne, E-Motors Consulting, LLC

9

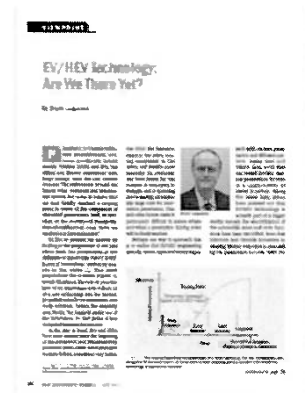
Publications

Available at: <http://www.emotorseng.com/selected-papers-and-presentations/>
or for patents at: https://www.google.com/?tbm=pts&gws_rd=ssl#tbm=pts&q=lequesne+bruno

- Patents: 53
- Papers (most recent)
 - "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
 - "A fast mechanical switch for medium voltage hybrid DC and AC circuit breakers", C. Peng, I. Husain, A. Huang, B. Lequesne, R. Briggs, IEEE Trans. on IA, Vol. 52, No. 4, July/Aug. 2016
 - "Automotive electrification: The non-hybrid story", invited paper, IEEE Transactions on Transportation Electrification, May 2015
- Presentations (recent)
 - "Electric machines for automotive propulsion: History and future", keynote presentation, IEEE ITEC-Asia-Pacific 2019, May 2019.
 - "Automotive motors: Recent accomplishments and challenges ahead", Presentation at Special Session at IEEE Energy Conversion Conference & Exhibition (ECCE), 09-2016.
 - "Automotive electrification: The non-hybrid story", Keynote presentation, IEEE International Transportation Electrification Conference, 06-2015.



Bruno Lequesne, E-Motors Consulting, LLC



Customers



 **BorgWarner**



Shark|NINJA



DENSO



Bruno Lequesne, E-Motors Consulting, LLC

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:
 - Technology roadmapping and strategizing, discerning new trends
 - Development of new concepts and products
 - Design of electric machines, linear actuators, and sensors
 - Intellectual property analysis and strategy, expert witness



Bruno Lequesne, E-Motors Consulting, LLC

12