

CONTINUING LEGAL EDUCATION SEMINAR  
New York, *free of charge*, by Videoconference

**DEFENSE ASSOCIATION OF NEW YORK (“DANY”) and  
NYC CHAPTER OF THE AMERICAN BOARD OF TRIAL  
ADVOCATES (“ABOTA”)**

will present the following seminar:

**THE BIOMECHANICS OF INJURY CAUSATION –  
TRAUMATIC BRAIN INJURIES**

by Videoconference via ZOOM

Defense Association of New York has been granted CLE accreditation by the Office of Court Administration -

1.0 CLE Credit will be granted in Skills

**Thursday, May 14, 2020**

**6:00 p.m. – 7:00 p.m.**

**TO JOIN THE SEMINAR:**

**<https://zoom.us/j/96375306731>**

**Meeting ID: 963 7530 6731**

**Password: arcca**

**Panel:**

**Steven Balson-Cohen, Esq.** - Captive Trial Counsel, American Transit Insurance Company  
**Calum G.A. McRae, Ph.D, M.Eng** of ARCCA - Senior Biomechanist

Sponsored by: ARCCA

**NO FEE: Free for DANY and ABOTA Members,  
Free for Non-Members**

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**PRESIDENT-ELECT:** Teresa A. Klaum, Esq.

**CLE COMMITTEE:** Teresa A. Klaum and Bradley J. Corsair, Chairs;

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## The Biomechanics of Injury Causation- Traumatic Brain Injuries

Total Time: 1 hour

### Course Description:

This seminar describes the foundational methods used during biomechanical analyses of injury causation with a particular emphasis on traumatic brain injury (TBI). The presenting biomechanist will openly discuss core concepts regarding physics and engineering, as well as human anatomy and physiology in understandable terms using real-world examples and field experience. The audience will come to appreciate the terms and principles used in biomechanics such as Delta-V, acceleration, injury mechanisms, injury assessment reference values, human tolerance, and personal tolerance.

### I Overview (10 minutes):

1. Foundational principles of biomechanics
2. Real-world examples of biomechanical analyses:
  - a. Vehicle crashworthiness
  - b. Occupant protection system design and implementation
  - c. Protective equipment
3. Question and answer period

### II Accident Reconstruction (15 minutes):

1. The meaning of Delta-V and Acceleration as input parameters
2. The utility of government crash testing (i.e. vehicular stiffness coefficients)
3. Energy-based crush analysis (EBCA)
4. Real-world examples of using an EBCA
5. The utility of low-speed crash testing performed by the Insurance Institute for Highway Safety (IIHS)
6. Damage-based speed change analysis (DBSCA)
7. Real-world examples of using a DBSCA

### III Injury Mechanisms as a Fundamental Concept for Biomechanical Analyses (25 minutes):

1. The meaning and importance of an injury mechanism
2. The differences between a medical doctor and a biomedical engineer
3. Real-world examples of an injury mechanism
4. Defining Traumatic Brain Injury (TBI)
5. The three main categories of TBI and their injury mechanisms:
  - a. Penetrating brain injury
  - b. Focal brain injury
  - c. Diffuse brain injury
6. Skull fracture biomechanics
7. TBI related injury assessment reference values, human tolerance, and helmet standards
8. Assessing TBI in the context of pre-existing conditions
9. TBI specific case studies and real-world examples (redacted where necessary):
  - a. Automotive collision with diffuse brain injury (i.e. concussion) claimed and full-scale reconstruction
  - b. Instance of blunt impact with focal brain injury claim
  - c. Product liability example with helmet applicability and injuries that included skull fracture, focal brain trauma, and coup/contre-coup brain injuries
  - d. Falling object reconstruction with consideration for injury assessment reference values and their applicability to injury causation analysis

### IV Closing (10 minutes):

1. Reiterate fundamental concepts including:
  - a. Accident reconstruction
  - b. TBI types
  - c. Injury mechanisms
2. Discuss the applicability of similar analyses to other types of injuries
3. Question and answer period

# **ABOTA – DANY BIOMECHANICS/ TBI PRESENTATION**

**MAY 14, 2020 – LEGAL PERSPECTIVES**

**(Presented by Steven Balson-Cohen Esq.)**

## **Section I: Diagnostic Modalities**

- Modern medical science has at its disposal various tools to diagnose what has been often called ‘the unseen injury’ namely the traumatic brain injury.
- X-rays can diagnose a skull fracture;
- Cat Scans and MRI can provide three dimensional views of acute and/or chronic brain injury/condition.
- Diffusion Tensor Imaging (DTI) these studies can enable the showing of evidence of an injury at a microscopic level (axonal fiber tracts and connections) and allows mapping of the white matter of the brain in both two and three dimensions.
- Positron Emission Tomography (PET scans) enable the proof of injury by illustrating brain function i.e. altered brain metabolic patterns.
- Using these tools in tandem with principles of biomechanical science can assist or disprove the traumatically claimed brain injury in a whole host of examples such as auto accidents, injuries involving falling objects and product based claims involving safety helmets in such as uses as football or motorcycles.

## **Legal Considerations**

- Counsel must be prepared to litigate the proposition that traumatic brain injuries can last a lifetime, condemning a victim to chronic problems. Brain injuries may not heal as other injuries. The death of brain tissue is particularly a focal part of any proof in such cases.

- While using biomechanical science in a TBI case may be different from the ordinary and every day practice it should be recalled that the rules for admission of expert testimony remain unchanged.
- Biomechanical science will be used in conjunction with established medical science to prove or disprove causation of brain injuries traumatically induced. Based on the case law below the medical arm of the proof may need to catch up as a reliable courtroom ally.
- Citations in this outline are from cases decided between 2008 - 2018 and represent the latest in case authority relevant to this presentation.

## **Section II: Legal Standards in Proving a TBI**

- Practice Note: DTI technology was seemingly accepted as authoritative in diagnosing minor TBI in LaMassa v. Bachman, 56 A.D.3d 340, 869 N.Y.S.2d 17 (1<sup>st</sup> Dept. 2008). The discussion of the below two cases ... particularly the 2<sup>nd</sup> case study sheds new questions on the finality of this holding.
- Practice Note: Please also see below Doveberg v. Laubach, 154 A.D.3d 810, 63 N.Y.S.3d 417 (2d Dept. 2017) (discussed at the end of this section) which reversed a defense verdict and wound up ruling that the lower court should have precluded a biomechanical expert (who was also a surgeon) from offering causation testimony before the jury.

### **1<sup>st</sup> Case study: Siracusa v. City Ice Pavilion LLC, 57 Misc.3d 267, 59 N.Y.S.3d 290 (Sup. Ct. Queens County 2017).**

**Motion Practice:** “Defendants moved to compel participant and his nonparty treating radiologist and/or nonparty medical center to provide complete magnetic resonance imaging (MRI) with diffusion tensor imaging (DTI) examination of participant, including all necessary control group data that was part of his neuro-radiological examination. Nonparties cross-moved for protective order”.

**The facts:** “On August 8, 2016, plaintiff Luna Siracusa participated in an ALS Ice Bucket Challenge held at a hockey rink owned and/or operated by defendant City Ice Pavilion, LLC (City Ice). The plaintiff allegedly sustained various injuries, including traumatic brain injury and the exacerbation of prior brain injuries”.

**The Medicine:** “On March 25, 2016, the plaintiff had an MRI–DTI performed, and Dr. Michael Lipton (treating radiologist) provided an analysis of it. The MRI part of the examination revealed that there was:

- (1) no recent or remote hemorrhage and that there was nothing remarkable about the ventricles and overall configuration of the brain
- (2) but Dr. Lipton's DTI analysis lead to the conclusion that the plaintiff has abnormally low FA levels, which is consistent with traumatic axonal injury although also consistent with other non-traumatic causes”. (Emphasis added).

**Acceptance of the Science of MRI-DTI:** “the general acceptance of the underlying scanning technology, which have already been determined and need not be revisited in this litigation .... (as) diffusion tensor imaging or DTI was accepted as a reliable means of diagnosing traumatic brain injury and accepted in the medical community.”

**The Legal Issue:** “The plaintiff regards Dr. Lipton as a treating radiologist. Without such a designation, the defendants cannot successfully argue that they need data base information, computer analysis, algorithms, and other matters for the purpose of knowing the foundation for his expert opinion pursuant to CPLR 3101(d)(1). An attempt to establish the permissible parameters of his anticipated trial testimony is premature at this point and may be established later via a motion in limine or at the trial”.

**Holding:** “The Supreme Court, Timothy J. Dufficy, J., held that MRI–DTI data base information was not subject to discovery. Defendants' motion denied; cross-motion granted”.

**2<sup>nd</sup> Case study:** **Brouard v. Convery, 59 Misc.3d 233, 70 N.Y.S.3d 820, (Sup. Ct. Suffolk County 2018).**

**Motion Practice:** Plaintiffs moved for an order from the Court to:

(1) To take judicial notice of the general acceptance and acceptability of technology known as Diffusion Tensor Imaging (“DTI”) pursuant to *Frye v. United States*, 293 F. 1013 (D.C. Cir. 1923); and

(2) To preclude Defendants from contesting any expert testimony put forth by Plaintiffs in regard to DTI technology.

**The motion facts:** “The facts which have prompted the Plaintiffs to make the above referenced motion are that methodology and technology utilizing DTI was used to examine Plaintiff in 2008 and 2014. Plaintiffs claim that this specific technology enjoys general acceptance by the scientific and medical community and therefore passes the long-recognized rule contained in *Frye v. United States*, 54 App.D.C. 46, 293 F. 1013 (D. C. Cir. 1923)”.

“Given the status of DTI, Plaintiffs contend that the Defense must be precluded from adducing any expert testimony claiming that any MRI using DTI technology is not generally accepted by the scientific/medical community to investigate mild TBI's”.

**The court’s reasoning:**

- “The march of science is inexorable. This has created a challenge for trial courts in deciding what “scientific” evidence is truly worthy of the name. How is a Judge, a presumed expert in jurisprudence, but

a lay person in science, to make such a determination? It is the Court's solemn duty to winnow the proof, finding and separating the modern day alchemy from chemistry as a metallurgist would remove dross from gold”.

- “In the ninety-five years since Frye was handed down to us case law and medicine have both developed. Other jurisdictions have abandoned the Frye analysis and embraced the reasoning in *Daubert v. Merrell Dow Pharmaceuticals*, 509 U.S. 579, 113 S.Ct. 2786, 125 L.Ed.2d 469 (1993), (see FRE Rule 702) ”.
- “New York, however has continued to follow the Frye rule, wisely leaving innovation to scientists and legislators”. (e.g. *Parker v. Mobil Oil Corp.*, 7 N.Y.3d 434, 824 N.Y.S.2d 584, 857 N.E.2d 1114 [2006]; *People v. Wesley*, 83 N.Y.2d 417, 611 N.Y.S.2d 97, 633 N.E.2d 451 [1994]”.

“As Frye evolved, its progeny added the refinement that the term general acceptance did not refer to a mere head-count of experts. Instead, it became clear that there should be a clinical (not just scientific) consensus, and that the proper foundation be laid as well as acceptable methods employed in each particular case....This is the analysis we apply to the instant controversy”.

**The holding: (Expert precluded).**

“A significant case cited by Plaintiffs is *LaMasa v. Bachman*, 56 A.D.3d 340, 869 N.Y.S.2d 17 [1st Dept. 2008]. The Appellate Court found that DTI technology met the Frye standard. At first glance this would seem to end the inquiry”.

“On the contrary, *La Massa* was followed by a white paper in 2014 which cast the First Department holding into doubt (M. Wintermark, P.C. Sanelli, Y. Anzai, A.J. Tsiouris and C.T. Whitlow on behalf of the American College of Radiology Head Injury Institute, *Imaging Evidence and Recommendations*



for Traumatic Brain Injury: Advanced Neuro- and Neurovascular Imaging Techniques, American Journal of Neuroradiology, November 2014)”.

“(T)he article concludes that there is insufficient evidence supporting the routine clinical use of advanced neural imaging for diagnoses and/or prognostications at the individual patient level”.

“In deciding the significance of the white paper (whose authenticity is not questioned), the Court is guided by the recent holding in *Dovberg v. Laubach*, 154 A.D.3d 810, 63 N.Y.S.3d 417 [2nd Dept.2017]”.

“The white paper by M. Wintermark et al. makes it clear that DTI technology is not generally accepted as yet in the field of neurology for use in the clinical treatment of individual patients. The rule in *LaMasa v. Bachman*, supra, though superbly researched and written, has been outpaced by current scientific knowledge”.

*“Accordingly, evidence of DTI technology must be shielded from the jury's review. Consequently, based on the issue of general acceptability in a given field, the Court finds that DTI does not (at the time of this writing) have a general acceptance to be used as the standard in clinical/medical treatment of individual patients who are being treated for TBI's”.*

### **Section III: The 2<sup>d</sup> Departments decision in *Dovberg*.**

*Dovberg v. Laubach*, 154 A.D.3d 810, 63 N.Y.S.3d 417 [2d Dept. 2017]”.

**Basis for the Appeal:** “In an action to recover damages for personal injuries, the plaintiff appeals from a judgment of the Supreme Court, Suffolk County (Whelan, J.), entered August 22, 2014, which, upon a jury verdict in

favor of the defendants on the issue of damages finding that the accident was not a substantial factor in causing her injuries, and upon the denial of her motion pursuant to CPLR 4404(a) to set aside the jury verdict as contrary to the weight of the evidence and for a new trial, is in favor of the defendants and against her, in effect, dismissing the complaint”.

**Facts:** “On the morning of September 11, 2001, the plaintiff was driving a Ford Taurus east on the Long Island Expressway when she was involved in a multivehicle accident. The accident occurred when a vehicle operated by the defendant Steven Laubach, and owned by the defendant Wheels, Inc. (hereinafter together the defendants), struck a vehicle operated by Scott Ramunni in the rear, propelling it into the rear of the plaintiff's vehicle. The plaintiff's vehicle was then propelled into a tow truck in front of her. The plaintiff alleges that the impact of the collision caused her body to lurch forward, and her knees to hit either

**The Biomechanical Expert:** “Prior to the commencement of a trial on the issue of damages, the defendants served an expert witness disclosure notice pursuant to CPLR 3101(d), advising the plaintiff that they intended to call Dr. Alfred Bowles, a biomechanical engineer and board-certified surgeon, who would testify that the force generated by the accident could not have caused any of the plaintiff's alleged knee injuries, and that those alleged injuries were the result of wear and tear from athletic activities. The expert disclosure notice indicated that the proposed testimony would be based upon Bowles's review of deposition testimony and the plaintiff's medical records”.

**Plaintiff's motion:** “The plaintiff moved in limine to preclude Bowles from testifying, arguing that his proposed testimony was speculative and without basis in fact, and that the expert disclosure notice did not make

reference to any empirical data that Bowles may have relied upon, or any peer-reviewed journals, studies, treatises, or texts showing that an accident that does not meet a specific severity threshold cannot cause injury”.

**Defendant’s opposition.** “In opposition, the defendants alleged that Bowles's testimony would be based on scholarly works that were published in the fields of medicine and biomedical engineering, and had gained general acceptance in those fields. In support of this claim, the defendants listed the names of three works, which, according to their titles, involved head, neck, and mandible injuries. The authors, years of publication, and contents of these works were not set forth. The Supreme Court denied the plaintiff's motion, and permitted Bowles to testify at the damages trial”.

“Bowles thereafter testified that in his opinion, with a reasonable degree of engineering certainty, the force generated by a low speed rear-end collision that propelled a vehicle into a 2000 Ford Taurus would not have caused the driver of the Ford Taurus to hit her knees against the dashboard”.

**Basis of the expert’s opinion:** “In reaching his conclusion, Bowles relied upon the defendant driver's deposition testimony that he was driving at a speed of no more than 10 miles per hour at the time of the collision, and the plaintiff's deposition testimony that she was driving at a speed of 3 to 5 miles per hour. Although Bowles did not know how close the plaintiff's seat was positioned to the steering wheel and dashboard at the time of the accident, he maintained that moving the seat up would not increase the likelihood of a driver's knees hitting the dashboard in a rear-end collision. At the conclusion of the damages

trial, the jury returned a verdict finding that the accident was not a substantial factor in causing the injuries alleged by the plaintiff”.

**The Court’s Reasoning:** “The long-recognized rule of *Frye v. United States* (citation omitted) is that expert testimony based on scientific principles or procedures is admissible but only after a principle or procedure has “gained general acceptance” in its specified field”.

“General acceptance does not necessarily mean that a majority of the scientists involved subscribe to the conclusion. Rather it means that those espousing the theory or opinion have followed generally accepted scientific principles and methodology in evaluating clinical data to reach their conclusions”. (Citations omitted).

“General acceptance can be demonstrated through scientific or legal writings, judicial opinions, or expert opinions other than that of the proffered expert” (Citations omitted).

“The burden of proving general acceptance rests upon the party offering the disputed expert testimony” (Citations omitted).

“Broad statements of general scientific acceptance, without accompanying support, are insufficient to meet the burden of establishing such acceptance” (Citations omitted).

“Furthermore, even if the proffered expert opinion is based on accepted methods, it must satisfy the admissibility question applied to all evidence-whether there is a proper foundation-to determine whether the accepted methods were appropriately employed in a particular case”. (Citation omitted).

**Essential Holding:** “Here, the defendants did not sustain their burden of establishing that Bowles's opinion that the force generated by the accident could not have caused the plaintiff's knee injuries was based on generally

accepted principles and methodologies (Citations omitted) or that there was a proper foundation for the admission of that opinion”. (Citation omitted).

“The expert disclosure notice simply stated that Bowles analyzed “the medical and engineering aspects of the accident.” While the defendants cited to three works in opposition to the motion in limine, they did not identify the authors, years of publication, and contents of those works, or any explanation as to their relevance in evaluating the cause of knee injuries”.

“Moreover, the defendants provided no description of the methodology Bowles utilized to determine the force of the accident, and the biomechanical engineering principles he relied upon in reaching his conclusion that the force generated by the accident could not have caused the plaintiff's knees to come into contact with the vehicle dashboard”.

“Under these circumstances, the Supreme Court should have granted the plaintiff's motion to the extent of precluding Bowles from offering his opinion testimony that the force generated by the accident could not have caused the plaintiff's knee injuries”. (Citations omitted).

“Accordingly, we reverse the judgment and remit the matter to the Supreme Court, Suffolk County, for a new trial on the issue of damages”.



## **STEVEN BALSON-COHEN, ESQ.**

### **Summary:**

- Trial attorney who in a 35 year career has tried over 150 jury cases to conclusion in New York and other States.
- Experience includes high exposure cases in professional negligence, toxic torts, motor vehicle/livery/trucking/train accidents, general liability, premises liability, labor law, trademark litigation, insurance coverage disputes, felony & misdemeanor representation in State and Federal courts.
- Conducted over 50 Frye & Daubert hearings on admission of expert testimony.
- Appellate representation and oral argument in New York State, other jurisdictions and on the Federal Appellate level.

### **Admissions:**

New York State; Pro Hac Vice admission in other States, United States District Courts for the Southern, Eastern, Northern and Western Districts of New York; United States Court of Appeals for the Second, Third and Fourth Circuits; United States Supreme Court.

### **Current Employment:**

#### **Law Offices of Steven Balson-Cohen, Esq.**

Captive Trial Counsel to the American Transit Insurance Company in transportation and livery related practice concentrating in trials and litigation of all aspects of active cases. Conducting Frye and Daubert hearings on the admission of expert testimony. Practice also includes pioneering anti-fraud programs for no-fault and property damage claims.

### **Career Highlights:**

Litigation in high exposure cases in State, Court of Claims and Federal courts. Jury trials, depositions, motion practice and appeals.

Practice areas include general liability, transportation litigation (automobile/livery/trucking/railroad), premises liability, asbestos litigation, professional negligence, patent and trademark litigation, product liability and labor law. Accomplishments include successful trials, appeals, summary judgment and mediation outcomes.

Experience includes professional disciplinary matters, white collar crime and high profile DWI cases, risk management for renowned food producer and coverage opinions author for internationally known insurance concern.

Youngest member ever invited to sit and deliberate on the official New York State Medical Malpractice Panels.

Well known litigation experience in Korean Airlines Litigation, Spantax aviation disaster, Three Mile Island Nuclear accident and Bhopal chemical disaster.

**Reported Decisions Include:**

- *Mueller v. County of Westchester*, 943 F. Supp. 357 (SDNY 1996),
- *Elkin v. Goodman*, 24 A.D. 3d 717, 808 N.Y.S. 2d 405 (2d Dept. 2005),
- *Scuderi v. Independence. Comm. Bank*, 65 A.D. 3d 928, 884 N.Y. S. 2d 861 (1st Dept. 2009),
- *Perez v. Gioroukos*, 75 A.D. 3d 488, 906 N.Y.S.2d 34 (1st Dept. 2010),
- *Martinez v. Hunts Point Coop. Market Inc.*, 79 A.D. 3d 569, 914 N.Y.S. 2d 99, (1st Dept. 2010).

**Most Satisfying Result:**

Obtained a defense verdict in a seven figure exposure medical malpractice case (Bronx County New York) for a local hospital whose insurance coverage was exhausted for the subject reporting year allowing it to remain open to serve the community for many years.

**AUTHORSHIPS & LECTURES:**

- ***“The Spoliation Doctrine and Lost Medical Records”*** New York Law Journal 9/28/05 (Cited in Simon's N.Y. Rules of Professional Conduct Section 3.4:6 "Spoliation and Electronic Evidence" (December 2018 Update)
- ***“Trial by Ambush and the Treating Physician”*** New York Law Journal 8/17/06 (Cited in *Kish v. Graham*, 40 A.D. 3d 118, 833 N.Y.S. 2d 313 (4th Dept. 2007).
- ***“Winning the Biomechanical Frye Hearing”***. New York Law Journal May 30, 2018.
- ***“Requiem for the Biomechanical Frye Hearing”*** New York Law Journal December 31, 2019.
- ***“Alice’s Law: Waterloo for Staged Accident Fraudsters?”*** New York Law Journal September 9, 2019.
- “Dental Records and How to Avoid Problems In Court” Lecturer at 2005 Annual New York Dental Meeting at The Jacob Javits Center.
- Panel Lecturer at “Frye Hearings and The Effective Use of Biomechanical Science” held on May 30, 2018 – CLE program sponsored by the Defense Association of New York and the American Board of Trial Advocates.

**MEMBERSHIPS:**

Diplomate of the American Board of Trial Advocates (ABOTA)  
(Officer – Secretary-of NYC Chapter)



The Defense Research Institute  
The Association of Trial Lawyers of America  
The Defense Association of New York  
New York State Bar Association  
Member of the New York State Medical Malpractice Panels.  
Appointed as a Presiding Judge at both Yale University and STAC Moot  
Court competitions.

**PRE ADMISSION LEGAL EXPERIENCE:**

**Office of the Attorney General, State of New Jersey**

Newark & Trenton, New Jersey

Law clerk in professional boards section. (Medical, dental and other licensed professionals such as architects). Experience includes writing motions, hearing preparations and drafting opinions of the Attorney General's Office.

**Office of the Public Defender - Bergen County - State of New Jersey**

Hackensack, New Jersey

Law clerk in criminal trial division. Experience includes drafting motions, appellate briefs, discovery responses and trial preparation.

**EDUCATION:**

Benjamin N. Cardozo School of Law

Juris Doctorate 1982

Yeshiva College B.A. Political Science 1979



## CALUM G. A. McRAE, Ph.D., MEng

### PROFESSIONAL BIOGRAPHICAL OUTLINE

#### BACKGROUND

Dr. McRae received his Masters of Engineering degree in Mechanical Engineering from the University of Glasgow, Scotland. He went on to obtain his Ph.D. in Biomedical Engineering from the University of Glasgow while performing research at the Queen Elizabeth National Spinal Injuries Unit in Glasgow, Scotland and Shriners Hospitals for Children, in Philadelphia, PA. Dr. McRae re-located to the United States in 2006 to complete a post-doctoral Fellowship with Shriners Hospitals for Children. Research included the development of novel technology to measure and control the musculoskeletal forces of individuals with neuromuscular impairments. This research was performed with both children and adults and tested within the clinical environment.

From 2007-2010 he was also employed as an adjunct Professor at Drexel University's School of Biomedical Engineering where he instructed Biomechanics. Dr. McRae's biomechanical experience includes testing, interpretation and teaching of human kinematics, kinetics, injury mechanisms and tolerance levels in both the clinical and research environment.

In addition to his experience in the field of biomechanics, Dr. McRae has training and professional experience in automotive engineering. Specifically, he spent time working at Mercedes-Benz Technology Center in Sindelfingen Germany performing research which involved analysis of motor vehicle dynamics and the creation of active safety system development tools for Mercedes-Benz.

Dr. McRae's academic and professional experience combines knowledge in biomechanical engineering, automotive engineering, live subject kinematic and kinetic testing, human anatomy and physiology, orthopedics, and neuromuscular prostheses. Currently, he specializes in the study of the kinematics and kinetics of the human body, as well as injury mechanisms and associated injury tolerances.

#### SUMMARY OF EXPERIENCE

- Performed various scientific investigations involving computational modeling and vehicle testing to investigate motor vehicle dynamics, active safety systems and human operator response.
- Designed and implemented, both experimentally and clinically, novel technology to measure and control the musculoskeletal systems of humans with neuromuscular impairments and degenerative conditions.
- Conducted scientific evaluations of the tolerance and injury mechanisms of the human neurological and musculoskeletal systems in the context of prior injury.
- Conducted scientific evaluations of the tolerance and injury mechanisms of the human neurological and musculoskeletal systems in response to impact forces.

#### AREAS OF SPECIALTY

- Injury Mechanism Analysis
- Vehicle Dynamics Analysis
- Neural Prostheses Design
- Human Kinematic Analysis and Testing
- Vehicle Active Safety System Design
- Spinal Biomechanics and Spinal Cord Injury



## EDUCATION

- Post-Doc (Biomedical Engineering), Shriners Hospitals for Children, Philadelphia, 2006-2009
- PhD (Mechanical/Biomedical Engineering), University of Glasgow, UK, 2002-2006
- MEng (Mechanical Engineering), University of Glasgow, UK, 1997-2002

## PROFESSIONAL EXPERIENCE

**08/2010 – Present | ARCCA, Incorporated | Senior Biomechanist**

**07/2009 – 08/2010 | Shriners Hospital for Children | Assistant Investigator**

**10/2007 – 09/2010 | School of Biomedical Engineering, Science and Health Systems, Drexel University | Adjunct Assistant Professor**

**10/2006 – 07/2009 | Shriners Hospital for Children | Postdoctoral Fellow**

**01/2006 -10/2006 | Dept of Mechanical Engineering, University of Glasgow | Research Assistant**

**10/2002-01/2006 | Dept of Mechanical Engineering, University of Glasgow | Teaching Assistant**

**06/2001-12/2001 | DaimlerChrysler AG, Mercedes Technology Center | Student Industrial Placement**

## TEACHING EXPERIENCE

- Instructor (School of Biomedical Engineering, Science and Health Systems, Drexel University, Philadelphia, PA) Biomechanics 2, Biomechanics 3 – 2007/2008, 2008/2009
- Instructor (School of Biomedical Engineering, Science and Health Systems, Drexel University, Philadelphia, PA) Biocomputational Languages – 2007/2008, 2008/2009, 2009, 2010
- Teaching Assistant (Department of Mechanical Engineering, University of Glasgow, Glasgow, UK) Control 4 – 2002/2003, 2003/2004, 2004/2005, 2005/2006

## MEMBERSHIPS TO PROFESSIONAL SOCIETIES

- Society of Automotive Engineers
- Association for the Advancement of Automotive Medicine

## PUBLICATIONS

**McRae, CGA**, Tokay Harrington A, Lee SCK. *Graded exercise testing by adolescents with cerebral palsy using a motor-assisted recumbent tricycle – maximal performance and the relation to gross motor function classification*. Dev Med Child Neurol. 2010: 52 (Supplement 5).

**McRae, C.G.A.**, Johnston T.E, Lauer R.T, Tokay A. M, Lee S.C.K, Hunt K.J, *Cycling for Children with Neuromuscular Impairments using Electrical Stimulation – Development of Tricycle-based Systems*, Med Eng Phys, 31(6), 650-9, July 2009.

**McRae, C.G.A.**, *Approaches to Functional Electrical Stimulation Induced Cycling and Application for the Child with a Spinal Cord Injury*, PhD Thesis, 2006.

Tokay Harrington A, **McRae, C.G.A.**, Lee, S.C. *Evaluation of Functional Electrical Stimulation to Assist Cycling in Four Adolescents with Spastic Cerebral Palsy*. Int. J. Pediatr. 2012:504387

Tokay Harrington A, **McRae, C.G.A.**, Lee, S.C.K. *The Effects of a Brief, Intensive FES-Assisted Cycling Intervention on Cycling Performance in Adolescents with Spastic Cerebral Palsy: A Case Series*. Pediatric Physical Therapy. 2011:23(1): 96-105.

## ABSTRACTS

**McRae, C.G.A.**, Prosser L, Hunt K.J, *Recreational Cycling for the Child with a Spinal Cord Injury Using Electrical Stimulation*, Proc. Howard H. Steel Conference on Pediatric Spinal Cord Injuries and Dysfunction, December 2009.

**McRae, C.G.A.**, Johnston T.E, Hunt K.J, Lauer R.T, *Work efficiency and stimulation cost during FES-cycling by children with a spinal cord injury*. Proc. 13th Ann. Conf. Int. Functional Electrical Stimulation Soc., (Freiburg, Germany), September 2008.

**McRae, C.G.A.**, Johnston T.E, Lauer R.T, Tokay A. M, Lee S.C.K, Hunt K.J, *A tricycle-based test bed for cycling using electrical stimulation by children with neuromuscular impairments* In Proc. AACPDM Annual Meeting, September 2008.

**McRae, C.G.A.**, Lauer R.T, Johnston T.E, Lee S.C.K, Smith B.T, Hunt K. J, Binder-Macleod S. A, *FES-cycling strategies for the child with a spinal cord injury using muscle force-stimulation relationships – a case study*. Proc. 12th Ann. Conf. Int. Functional Electrical Stimulation Soc., (Philadelphia, USA), November 2007.

**McRae, C.G.A.**, and Hunt K.J, *Development of Methods and Equipment for Functional Electrical Stimulation Induced Cycling for Use Within The Paediatric Spinal Cord Injured Population*, in Proc. 4th Annual. IEEE EMBSS UK and RI Postgraduate Conference in Biomedical Engineering and Medical Physics., Reading, UK, 2005.

Tokay A.M, **McRae, C.G.A.**, Johnston T.E, Lee S.C.K, *Functional electrical stimulation-assisted cycling in adolescents with cerebral palsy* Accepted for CSM of the APTA Annual Meeting, February 2009.

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Tokay A.M, **McRae, C.G.A.**, Johnston T.E, Lee S.C.K, *The feasibility of using functional electrical stimulation assisted cycling in children with CP*. Presented at the 5th Annual Center for Biomedical Engineering Research Symposium, University of Delaware, Newark, DE, 2008.

Tokay A.M, **McRae, C.G.A.**, Johnston T.E, Lee S.C.K, *The Feasibility of Using Functional Electrical Stimulation Assisted Cycling in Children with Cerebral Palsy*. Proc. 12th Ann. Conf. Int. Functional Electrical Stimulation Soc., (Philadelphia, USA), November 2007

Lee SCK, Harrington AT, **McRae, CGA**. *FES-assisted cycling training can improve cycling performance, cardiorespiratory fitness, strength, gait and functional activity following an 8-week, home-based training program-A case report*. Accepted for presentation at the 15th Annual Conference of the International Functional Electrical Stimulation Society; Vienna, Austria; September 2010. *Biomedizinische Technik – Biomedical Engineering*. 2010: 55 (Supplement)

## PRESENTATIONS

- March 2009**      *Cycling for the child with Neuromuscular Impairments Using Electrical Stimulation*, Department of Neurobiology and Anatomy, Drexel College of Medicine, Philadelphia PA.
- February 2009**      *Pediatric FES-cycling*, Shriners Hospitals for Children Scientific Staff Meeting.
- October 2008**      *Work efficiency in pediatric SCI*, Scottish Centre for Innovation in Spinal Cord Injury, Queen Elizabeth Spinal Injuries Unit, Southern General Hospital, Glasgow, UK.
- October 2007**      *FES-cycling for the child with Neuromuscular Impairments*, Department of Mechanical Engineering, University of Glasgow, Glasgow, UK.
- September 2007**      *FES-cycling – Improving performance of riders with SCI – International Functional Electrical Stimulation Society Pre Conference Course*, Shriners Hospitals for Children, Philadelphia.

## RESEARCH SUPPORT/AWARDS

- 1 R01 HD062588-01A1 Lee (PI)  
National Institute of Child Health and Human Development (NICHD) at the National Institutes of Health, *FES-assisted Cycling to Improve Fitness and Strength in Children with CP*, Role: Co-investigator
- 9159 Lee (PI)  
Shriners Hospitals for Children Clinical Research Grant, *Functional Electrical Stimulation Assisted Cycling to Improve Fitness and Strength in Children with Cerebral Palsy*, Role: Co-investigator
- 8507 McRae (PI)  
Shriners Hospitals for Children Fellowship Grant, *A pilot study of novel techniques to maximize the health and fitness benefits of FES-cycling in children with spinal cord injuries*, Role: PI