IN THE MATTER OF THE COMMISSION OF INQUIRY

INTO THE DEATH OF DONALD DUNPHY

Ruling 1: Application to Retain Biomechanical Expert

I. Introduction

The Applicant, Meghan Dunphy, has applied to have Dr. Stephen Czarnuch, a biomechanical engineer, called as an expert witness, to testify concerning the submission of self-defence made by Constable Joseph Smyth in the shooting death of her father, Donald Dunphy. Ms. Dunphy seeks to have Dr. Czarnuch establish the physical movements involved and the time required for Donald Dunphy to access a rifle from his right hand side while seated in his chair. A copy of the application with an attached description of the proposed experiment and the qualifications of Dr. Czarnuch is attached as Appendix A.

II. Background Facts

Cst. Smyth has testified that, while questioning Donald Dunphy at his home, Mr. Dunphy raised a 22 calibre rifle from somewhere on the right side of the chair in which he sat and pointed it at the police officer. Cst. Smyth said that at the time he was looking down at a folder on which he was making notes and saw Mr. Dunphy in his peripheral vision. Cst. Smyth estimates he had been looking away from Mr. Dunphy for anywhere from two to six seconds.

Ms. Dunphy says she believes that the proposed expert evidence will establish that her father could not have raised the rifle in the manner stated by Cst. Smyth in the time he set out.

III. Submissions

(a) Meghan Dunphy

Counsel for Ms. Dunphy submits that the proposed experiment regarding the physical movements necessary to raise a rifle in the manner alleged and the time it would take would provide relevant and necessary evidence regarding whether Mr. Dunphy could have acted as he allegedly did within the suggested time frames. Counsel submits that this biomechanical engineering methodology would produce a reliable evidence-based standard against which the veracity of Cst. Smyth's testimony might be tested and, together with the evidence from other sources, would assist the Commission in addressing its Terms of Reference, particularly those mandating inquiry into the circumstances of death and the ascertaining of whether there were any material deficiencies in the investigation of the death.

Counsel says that if the time needed by Mr. Dunphy to raise the rifle exceeds the time Cst. Smyth estimates he was not looking at Mr. Dunphy, then this would raise doubts as to Cst. Smyth's credibility. First, it would raise the possibility that Cst. Smyth may have had time to escape the room or take other action short of lethal force. Second, if the time needed by Mr. Dunphy to raise the rifle was relatively long, or involved a significant physical movement, it casts doubt on Cst. Smyth's assertion that he did not see the rifle until it was pointed at him.

(b) Cst. Joseph Smyth

Counsel for Cst. Smyth submits the experimental conclusions would have to be premised upon so many estimated variables that the experiment would have little probative value. He notes that Cst. Smyth could easily have spent several seconds looking around the

living room and several more looking down at his folder. He also says that the principle of fairness binding a Commission when considering evidentiary issues requires that if evidence is submitted in support of serious misconduct alleged against an individual, then special care must be given as to whether or not to receive the evidence.

(c) *Other parties*

Other parties, except for the Ad Hoc Community Coalition, also oppose the application on various grounds, one ground being that a part of the experiment will require estimates of the effect of Mr. Dunphy's physical disabilities upon his ability to twist, turn and lift, matters outside the claimed expertise of Dr. Czarnuch.

IV. Issue

Whether the results of the proposed experiment would satisfy the test of relevant and necessary evidence.

V. The Law and Analysis

(a) Admission of expert evidence generally

The general rule that all relevant evidence is admissible has qualifications. In the present application we are concerned with the exclusionary rule for opinion evidence.

Normally a witness testifies to facts and does not express opinions about those facts. An exception where witnesses may offer opinions is in "matters of common experience", such as estimates of distance, or the speed of a vehicle, or the age of a person. See, Ratushny, The Conduct of Public Inquiries: Law, Policy and Practice (2009), at 323. Also, the law permits experts to express opinions in certain limited circumstances, where they are

qualified by some special skill, training or experience. The opinion must be on matters within their expertise. The subject matter must truly require expertise, be within a recognized discipline, and not be within the "common stock of knowledge" of the public. Ratnushy, at 323.

Assuming for the moment that the evidence which Dr. Czarnuch would produce through his experiment would in fact be expert evidence, I am satisfied, for the following reasons, that the proposed evidence does not meet the threshold test for admission of novel expert evidence.

(b) Admission of novel expert evidence

The proposed experiment falls within the category of novel scientific technique in that the expertise asserted as needed to carry it out does not fall within a previously recognized area of expertise.

In *R. v. Mohan*, [1994] 2 S.C.R. 9, the Supreme Court of Canada articulated the four part test to be considered with respect to the admission of novel expert evidence. The criteria are: (1) relevance; (2) necessity in assisting the trier of fact; (3) the absence of any exclusionary rule; and (4) a properly qualified expert.

Surprisingly, the Court did not expressly note the reliability of the evidence as one of the criteria to be considered. *Sopinka J.* did, however, at paragraph 18, refer to reliability in the context of relevance and when discussing the exclusionary rule relating to probative value. Also, at paragraph 28, *Sopinka J.* stated:

> In summary, therefore, it appears from the foregoing that expert evidence which advances a novel scientific theory or technique is subjected to special scrutiny to determine whether it meets a basic threshold of reliability and whether it is essential in the sense that the trier of fact will be unable to come to a satisfactory conclusion without the assistance of the expert. The closer the

> evidence approaches an opinion on an ultimate issue, the stricter the application of this principle.

The jurisprudence since *Mohan* has made it clear that the threshold reliability of the underlying science must be carefully considered in the case of novel scientific evidence or technique. See, for example, *R. v. J. (L.J.)*, 2000 SCC 51, [2000] 2 S.C.R. 600, and *R. v. Trochym*, [2007] 1 S.C.R. 239, 2007 SCC 6. In the present case, as explained below, the proposed evidence meets neither the necessity test nor the test of sufficient probative value and, therefore, I need not otherwise get into the assessment of reliability.

The *Mohan* test has been further refined by the more recent decision of *White Burgess Langille Inman v. Abbott and Haliburton Co.*, [2015] 2 S.C.R. 182. In that case, the Supreme Court of Canada held that the inquiry for determining the admissibility of expert evidence is to be divided into two steps. The first step is the establishment of the four factors set out in *R. v. Mohan* as a threshold requirement before moving on to the second. If the *Mohan* test cannot be met by the party seeking to adduce the evidence, then it should be excluded. If the *Mohan* criteria can be met, then the second step must be considered. This step involves the trier of fact engaging in a discretionary gatekeeping role to ensure that the evidence proposed is of sufficient probative value so as to outweigh any potential prejudice or harm to the Inquiry's process.

(i) Relevance

In the present case the proposed experiment has some relevance in that I believe the results, if achievable, would, to some extent, advance this Inquiry because they would have a bearing upon an issue to be resolved, namely whether the description of the incident by Cst. Smyth is plausible. If it could be established that Mr. Dunphy could not have brought the rifle to bear upon Cst. Smyth within the alleged time frame, then this would challenge

Cst. Smyth's testimony that he had insufficient time to see the raising of the rifle or to exit the living room and his only choice was to shoot at Mr. Dunphy.

(ii) Necessity

From the information provided concerning the proposed experiment, I do not believe that the times required for the alleged actions of Mr. Dunphy can be established with sufficient certainty to be considered necessary. The results of the proposed experiment will depend upon too many variables or hypotheticals. These include the various possible locations of the rifle, the various possible angles of the firearm if placed in a pocket on the side of Mr. Dunphy's chair, the various possible degrees of disability of Mr. Dunphy, the various possible effects of agitation or adrenalin with respect to Mr. Dunphy at the time, the various positions he might have adopted in his chair (left side, middle or right side), the various ways Mr. Dunphy may have held the rifle (with one hand or two), and so forth. The evidence resulting from the proposed experiment will provide answers to what are hypothetical questions – where there is no agreement on the factual basis of the questions.

In *R.v.J.J.*, 2000 SCC 51, *Binnie J.* for the Court adopted the conclusion of *Sopinka J.* in *Mohan* that the expert opinion must be necessary "in the sense that it provide information, which is likely to be outside the experience and knowledge of a judge or jury; … the evidence must be necessary to enable the trier of fact to appreciate the matters in issue due to their technical nature."

The proposed expert says that the planned times and motion trials "will help understand both the *average* time it takes to perform the considered action as well as the amount of variation one could reasonably expect as a result of individual capabilities." In other words, these trials will provide an expected range of times it would take for a healthy

adult male to perform the necessary actions for each possible location and position of the rifle and then these times would be adjusted, based upon estimates of how physical and mental capabilities would affect Mr. Dunphy's deviation from the average.

I have not been shown that the adjustment process is within the expertise of Dr. Czarnuch. He properly pointed out that to establish the extent to which Mr. Dunphy's physical disability may in fact have caused him to take more time than a young, healthy adult male to draw a weapon would require a better understanding of Mr. Dunphy's disability than is currently known at this time. I note that Mr. Dunphy's physician could provide only very general information in this regard. Dr. Thomas McGarry testified that Mr. Dunphy had suffered a crushed pelvis and would have some difficulty bending and twisting as a result of his physical problems. He had trouble getting out of a chair and was slow in his movements compared to a normal person.

Even if one were able to arrive at a reliable deviation for disability, this would point to a different result for each variable, including the assumed location and angle of the rifle, each position of Mr. Dunphy in the chair and each method of holding the firearm. This series of results would not be of significant assistance to this Inquiry, particularly considering the time period of interest ranges from only two or three to five or six seconds. Because the experimental evidence to be obtained will be too speculative and uncertain to be of assistance, the applicant has not shown it will be "necessary". She fails to meet the "necessity" criterion of *Mohan* or the first step of *White Burgess*.

(iii) Probative Value

In any event, considering the second step of *White Burgess*, I have concluded that the average times to be obtained under the many scenarios and variations would be of

insufficient probative value to justify embarking upon the process of carrying out the proposed experiment. Indeed, I should say experiments. Fairness to Cst. Smyth would require that he have time to search for an expert in rebuttal if the results of the first experiment were not acceptable to him. This would mean delay in seeking experts. Eventually a battle of experts would ensue and it would be very difficult to meet the deadline for the submission of the Commission's Report.

(c) A Matter of Common Experience

A good argument can be made that the evidence in question is not expert evidence at all. An expert may not be necessary, in that, for the most part, we are dealing with matters of common sense and something within the "common stock of knowledge" of the public. We can all roughly estimate within a second or so how long it would take a 58 year old man to raise a firearm if he has certain disabilities resulting in loss of flexibility or mobility. Such an estimate would arguably be as useful for present purposes as would the averages obtained by the proposed experiment.

One may question whether the proposed experiment involves anything more than a sophisticated measurement of distances and times, which non-expert members of the general public could perform or approximate by reasonable estimation. I have not been shown the usefulness of having detailed explanations of the movements involved or of the "biomechanical modeling of the posture and pose deformation potentially required to reach the weapon". The question is how many seconds or milliseconds it would take a person in Mr. Dunphy's situation to grab, raise and point the rifle. This is something which may fall within "matters of common experience" as opposed to an area of expertise or a particular discipline. But whether experimental results are sought to be put in through an expert or by

a demonstration of a non-expert, the same problem arises: there are too many variables at play to permit inferences to be drawn with the necessary degree of certainty. The probative value of the evidence will be insufficient to warrant the delay involved in obtaining it, whether the evidence goes in through an expert or non-expert. I am satisfied I will be able to arrive at satisfactory conclusions on the issues in question without the assistance of experts or experiments.

(d) The Chair Demonstration

To avoid any misunderstanding by counsel, I must note that what I have stated above will not prevent counsel from utilizing Mr. Dunphy's chair as a demonstrative aide in the course of final submissions.

Summary and Disposition

If viewed as novel expert evidence, the results of the proposed experiment or experiments will not meet the necessity test of *Mohan.* The experimental results will be too speculative and uncertain because of the many variables involved. For the same reason, the results will not have sufficient probative value to warrant admission. If the evidence is viewed as a matter of common experience, the same problems of too many variables and lack of probative value arise. I have kept in mind the importance Meghan Dunphy places upon what she sees as evidence which may challenge Cst. Smyth's testimony regarding how he had no choice but to shoot her father in order to save himself. But in law this sort of evidence does not go in. I should note that I will be considering the available non-experimental evidence regarding difficulties Mr. Dunphy might have had in raising the rifle and I will be arriving at my own independent conclusion as to

whether Cst. Smyth's description of what occurred is plausible. I do not need expert opinion in order to do this. The application is dismissed.

Leo Barry
Commissioner

2017-03-21

APPENDIX A

SULLIVAN + BREEN + KING

Robert E. Simmonds, QC (Counsel) + Rosellen Sullivan + Erin K. Breen + Michael N.R. King + Ellen C. O'Gorman

January 13, 2017

Commissioner Leo Barry
Commission of Inquiry into the Death of Donald Dunphy
Filed via e-mail attachment

Dear Commissioner Barry:

Re: Application on behalf of Meghan Dunphy to have Dr. Stephen Czarnuch, Biomechanical Engineer, called as an expert witness

As directed by the Commission on January 7, 2017, we provide this letter as the Application of Ms. Dunphy for the Commission to call Dr. Stephen Czarnuch, biomechanical engineer, as an expert witness. Dr. Czarnuch's CV and preliminary report setting out his proposed methodology have been provided.

We submit that Dr. Czarnuch's opinion will assist the Commission with respect to subsections 3(1) (f) and (j) of the terms of reference.

Constable Smyth has stated that Mr. Dunphy, while seated in his chair, obtained a rifle from his right hand side and then pointed the rifle while Constable Smyth stood across from him. Constable Smyth stated that he did not see this take place although he had Mr. Dunphy in his peripheral vision. The physical movements necessary to obtain a rifle in this manner and the time it would take are not known. Dr. Czarnuch's preliminary statement proposes a biomechanical engineering methodology that will produce a reliable standard against which the veracity of Constable Smyth's testimony may be tested. Dr. Czarnuch's output would not be within the common knowledge of the Commission and would assist the Commission in its analysis of this material issue.

Respectfully submitted,

ERIN K. BREEN AND ROBERT E. SIMMONDS Q.C.

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Preliminary Statement related to the Commission of Inquiry Respecting the Death of Donald Dunphy

Prepared for:

Erin Breen and Robert Simmonds, Q.C.,

SBK – Defense

Prepared by:

Stephen Czarnuch, Ph.D., P.Eng.
Assistant Professor
Department of Electrical and Computer Engineering,
Faculty of Engineering and Applied Science /
Discipline of Emergency Medicine, Faculty of Medicine
Memorial University of Newfoundland

January 12, 2017

Introduction

This statement is prepared in response to an email sent to me by Ms. Erin Breen on Sunday, January 8, 2017 at 4:36pm. I was provided with the following evidence for my preliminary statement:

1. Statement of Joseph Smyth – December 22, 2015 (transcripts);
2. Statement of Joseph Smyth – June 17, 2015 (transcripts);
3. A binder of approximately 40 photos of the room;
4. A three-page document beginning with a short statement followed by a Twitter tweet (unknown source); and
5. A one-page floorplan of Mr. Dunphy's house, titled Appendix II (p.23, unknown source)

My statement is solely based on these documents and contextualized by the original email sent by Ms. Breen.

Expertise in the area

I obtained my PhD in biomedical engineering at the University of Toronto in 2014, with a specific focus on human motion tracking, task and activity identification, detection and monitoring. My research on computer vision-based human motion tracking began in 2009 when I started my PhD, and is now largely centred on biomechanical modeling of humans and human motion in three-dimensions. My work in this area is largely focused on persons with physical and cognitive disabilities (e.g., dementia, multiple sclerosis), and has resulted in over ten peer-reviewed scholarly publications in the area [e.g., 1, 2-10]. Prior to my PhD, I worked for over a decade as an electrical and computer engineer, and spent the last five years of this period specializing in computerized human tracking and task identification in a manufacturing setting. Finally, through my research I routinely conduct motion trials with humans in an attempt to identify tasks and activities, including timing human motion.

Experience providing expert opinion in a judicial hearing

I have never provided an expert opinion in a judicial hearing.

Awareness and understanding of the role of an expert witness in a judicial proceeding.

I understand that my role as an expert witness is to maintain impartiality. With respect to my involvement in the Dunphy case I understand that all of my correspondences are to be documented, ideally in written form, to the greatest extent possible. Furthermore, any methodologies that I employ and opinions that I express must be scientifically based and unbiased toward any result. I am familiar with this role as an ongoing expectation of my role as a professional, as evidenced by my ongoing certification as a licensed and practicing Professional Engineering in the Province of Newfoundland and Labrador, member #08223.

Declaration of any bias, real or perceived, that may exist.

I hold no personal bias with respect to this role. In the interest of full disclosure of real or perceived conflicts of interests, I believe it prudent to disclose that my partner, Dr. Rosemary Ricciardelli is an Associate Professor in the Department of Sociology and the Coordinator of the Criminology Certificate at

Memorial University. She specializes in corrections research although does limited policing research as well. In her academic role, she serves on the police studies academic advisory committee and may teach Royal Newfoundland Constabulary (RNC) cadets (or future cadets) in her classes. She does work in partnership with the Royal Canadian Mounted Police (RCMP), B Division and has engaged in research with the Child Abuse and Sexual Assault Unit as well as that of the Child Internet Exploitation Unit of the RNC. To the best of her knowledge, she does not know Smyth nor anything beyond public knowledge of the Dunphy case.

Understanding of the questions being asked to consider for the Commission.

I am confident I fully understand the questions I am being asked to consider for the Commission. Namely, I am being asked to consider:

1. What physical movements were required for Mr. Dunphy (with the parameters outlined below) to obtain the rifle from his right hand side while seated in his chair?
2. How long, time wise, could these actions take?

I also understand that my proposed consideration and procedure must contemplate all reasonable possibilities, including the quickest and easiest way that the rifle could be obtained *by a young and fully able-bodied adult male*. To accomplish this, and implicit to my methodology, will be the determination of the possible/probable locations the rifle could have been stored during the exchange between Mr. Smyth and Mr. Dunphy while remaining accessible to Mr. Dunphy, but potentially not visible to Mr. Smyth.

Methodology and proposed results

I propose three main steps: 1) identify possible classes of locations for the rifle; 2) biomechanical modeling of a young and fully able-bodied adult male (of the same height and basic measurements of Mr. Dunphy) reaching for the rifle; and 3) timing trials with a representative sample of young and fully-able-bodied males. In this way, I expect to be able to produce the following results:

1. A list of possible locations to the right of the chair that the rifle could have been stored and accessible to Mr. Dunphy but potentially not visible to Mr. Smyth, categorized by classes.
    - In this context, a *class* would refer to a location that would be accessible by the same or similar physical and anatomical human movements, while allowing for some variation in the actual placement. For example, a class could be identified as "on the floor, approximately parallel to the chair with the barrel toward the mantle".
    - Accessible to Mr. Dunphy suggests that he could reach the rifle without leaving his chair.
    - Potentially not visible to Mr. Smyth suggests that, under some circumstances Mr. Smyth may have been able to see the rifle, but that is was possible he could not see it depending on location, environmental conditions, etc.
    - Location classes would be identified by physical dimensioning and examination of the room and rifle.
2. A static biomechanical model of a young, able-bodied male of similar anatomical dimensions to Mr. Dunphy in his chair, and reaching for the rifle in the location classes identified in the first step.
    - This model will primarily identify the transformation of the posture and positioning of a man similar to Mr. Dunphy that would be required under ideal conditions to reach the rifle.
    - This modeling may also discount certain possible locations based on the motions required to reach them.

3. A set of simulated or real trials to help characterize how long, time wise, it would take a young, able bodied adult male to obtain the rifle into a defined position.
    - The position, currently, has not been fully defined but may include: the rifle being held by the grabbing hand; the rifle being held by both hands; the rifle being held and pointed at the probable location of Mr. Smyth by the mantle without necessarily being oriented properly; the rifle being held and pointed at Mr. Smyth and oriented properly.
    - The use of simulated trials (i.e., in a mock setting with objects of similar dimensions) versus real trials (i.e., in the Mr. Dunphy's home) will be determined under the advisement of the Commission.
    - The number of participants required to characterize a young, able-bodied adult male will be determined under the advisement of the Commission
    - These trials will help understand both the *average* time it takes to perform the considered action, as well as the amount of variation one could reasonably expect as a result of individual capabilities. In other words, these trials will provide an expected range of times it would take for a healthy adult male to perform the action for each possible location of the rifle.

How this opinion would assist the Commission in carrying out its mandate

From the data collected using the stated methodology, one could gain an understanding of the amount of time it would likely take for a seated, able bodied adult male to, for example, reach for the rifle in in a known storage location, properly orient the rifle (for example if it was picked up upside down), and point the rifle toward the mantle. These data could also be compared across possible rifle locations. From these data, in conjunction with the biomechanical modeling of the posture and pose deformation potentially required to reach the weapon, and from a review of the timing trials, one could also gain an evidence-based understanding of what Mr. Smyth may have seen, directly or peripherally, if a young, able-bodied adult male were reaching for and drawing the rifle from Mr. Dunphy's seat. Finally, and in consideration of any disability or injury Mr. Dunphy may have had, one could opine on how these data collected from a young, able-bodied adult male could have been affected. For example, an assertion could be made that Mr. Dunphy's physical disability or injury may in fact cause him to take more time than a young, healthy adult male to draw his weapon. However, this assertion would require a better understanding of Mr. Dunphy's disability than is currently known at this time.

References

[1] A. J. R. Hynes and S. Czarnuch, "Assessing the gait of people with multiple sclerosis using 3D motion tracking: toward objective outcome measures," in *Americas Committee for Treatment & Research in Multiple Sclerosis (ACTRIMS)*, Orlando, FL, 2017.

[2] S. Czarnuch and A. Mihailidis, "Development and evaluation of a hand tracker using depth images captured from an overhead perspective," *Disability & Rehabilitation: Assistive Technology,* vol. 11, pp. 150-157, 2016.

[3] S. Czarnuch and M. Ploughman, "Toward inexpensive, autonomous, and unobtrusive exercise therapy support for persons with MS," in *Americas Committee for Treatment & Research in Multiple Sclerosis (ACTRIMS)*, New Orleans, LA, 2016.

[4] A. J. R. Hynes and S. Czarnuch, "Combinatorial Optimization for Human Body Tracking," in *Lecture Notes in Computer Science, Proceedings of the International Symposium on Visual Computing*, Las Vegas, NV, 2016.

[5] A. J. R. Hynes and S. Czarnuch, "Building a feature vector for assessing the gait of persons with multiple sclerosis," presented at the Newfoundland Electrical and Computer Engineering Conference, IEEE, Newfoundland and Labrador Section, St. John's, NL, 2016.

[6] Z. Yang and S. Czarnuch, "3D Point Cloud based Human Skeleton Identification," presented at the Newfoundland Electrical and Computer Engineering Conference, IEEE, Newfoundland and Labrador Section, St. John's, NL, 2015.

[7] S. Czarnuch, "Advancing the COACH automated prompting system toward an unsupervised, real-world deployment," Doctor of Philosophy, Institute of Biomaterials and Biomedical Engineering, University of Toronto, Toronto, 2014.

[8] S. Czarnuch and M. Ploughman, "Automated gait analysis in people with Multiple Sclerosis using two unreferenced depth imaging sensors: Preliminary steps," presented at the Proceedings of the Newfoundland Electrical and Computer Engineering Conference, IEEE, Newfoundland and Labrador Section, St. John's, NL, 2014.

[9] S. Czarnuch and A. Mihailidis, "Development and evaluation of a hand tracker using depth images captured from an overhead perspective," presented at the Newfoundland Electrical and Computer Engineering Conference, IEEE, Newfoundland and Labrador Section, St. John's, NL, 2014.

[10] S. Czarnuch, S. Cohen, V. Parameswaran, and A. Mihailidis, "A real-world deployment of the COACH prompting system," *Journal of Ambient Intelligence and Smart Environments, Thematic Issue on Designing and Deploying Intelligent Environments,* vol. 5, pp. 463–478, 2013.

Robert Simmonds

From: Stephen Czarnuch <stephen.czarnuch@gmail.com>
Sent: January-16-17 11:58 PM
To: Robert Simmonds; Erin Breen
Subject: Clarifying statements

Dear Robert and Erin,

I am sending this email as a follow-up to our phone conversation earlier this evening, and specifically, our discussion of my role as an expert witness to the Commission. For the sake of brevity I am assuming that my Preliminary Statement, which I submitted to Ms. Breen on January 12, outlining my proposed methodology is available. The intent of this email is to provide you with further details on the following three points raised this evening:

1. ***My title of Biomedical Engineer, as compared to Biomechanical Engineer.*** Biomechanics, broadly speaking, is the study and analysis of human movement. Biomechanical engineering is thus the application of engineering principles to the movements of living things. Biomedical engineering is, broadly speaking, the study of biological systems (including humans) using engineering principles. I can cite numerous sources that consider one to be the more generalized form of the other and vice versa. However, in my opinion, particularly in this situation, the field of study is more relevant than the title. I received my PhD from the Institute of Biomaterials and Biomedical Engineering at the University of Toronto. My research has almost entirely focused on the application of engineering principles to the skeleton modeling of human motion and human activity detection. All graduates of this PhD program hold the same title, but conduct extremely different research suggesting that the title is not as relevant as the research. For example, a biomechanical engineer could focus specifically on the biomechanics of hearing or speech, while a biomedical engineer could focus entirely on human kinematics and motion analysis.
2. ***An estimate of the time and cost of completing the proposed work.*** Please refer to my Preliminary Statement for details on the methodology. I anticipate it will take 20-25 hours @ $200/hr to complete the following work:
    1. Identify the possible location(s) of the rifle;
    2. Model the static biomechanics (posture and body positioning) of a young, able-bodied adult male (of similar dimensions to Mr. Dunphy) reaching for the rifle in the identified location(s); and
    3. Complete a small set of simple trials, if necessary, to develop a preliminary characterization of the pose, time, and effort it may take to reach the rifle in the identified locations.
3. ***My ability to complete my proposed work by February 17, 2017.*** I do not anticipate any difficulties that will prevent me from completing the work by February 17. This is conditional on a minimum of transportation and access to Mr. Dunphy's home with the chair in it's original place, and access to the rifle to take measurements.

If you have any further questions, please let me know.

Sincerely,

Stephen Czarnuch, PhD, P.Eng.
Assistant Professor

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1 EDUCATION

Degree	Institution	Department	Year
Ph.D.	University of Toronto	Institute of Biomaterials and Biomedical Engineering	2014
M.A.Sc.	McMaster University	Electrical and Computer Engineering	2005
B.Eng. & Mgmt.	McMaster University	Electrical and Computer Engineering	2002

2 EMPLOYMENT HISTORY

2.1 Academic Appointments

2015-present Assistant Professor
Memorial University

2014-2015 Post-doctoral fellow
Memorial University
St. John's Canada
Co-advisors: Dr. Ray Gosine (Engineering), Dr. Michelle Ploughman (Medicine)
Title: Toward automated rehabilitation support and progress assessment for people with Multiple Sclerosis: Improving recovery, objectivity and safety with technology

2014, Spring Per-course instructor, Concurrent Programming
Memorial University
St. John's Canada

2002, Fall Teaching Assistant, Electrical Machines
McMaster University
Hamilton Ontario

2002, Winter — Teaching Assistant, Microelectronics
McMaster University
Hamilton Ontario

2.2 Non-Academic Appointments

2005-2014 — Electrical Engineer
General Motors of Canada
Oshawa, Ontario

- Created and supervised the implementation of research and development projects to improve manufacturing processes
  - Independently conceptualized and lead large-scale research based projects (up to $250,000) to support manufacturing requirements such as:
    - Designing a human tracking systems to enforce the safety and security of manufacturing personnel in unsafe areas
    - Creating an innovative human-object interaction detection system to ensure compliance with safety regulations during the installation of critical vehicle components
  - Collaboratively contributed to team-based, interdisciplinary projects valued at as much as $1 million, such as:
    - Redesigning infrastructure for tracking and verifying build data and processes across the General Motors Oshawa Car Plants
  - Explored the application of leading-edge hardware to improve manufacturing accountability and traceability
  - Designed custom industrial Human-Machine Interfaces to allow seamless interaction between process equipment, skilled trades and unskilled production workers
  - Supervised teams of skilled trades during the installation and validation of process equipment
- Autonomously provided engineering support for automated process equipment
  - Utilized problem solving skills to diagnose equipment failures and resolve chronic manufacturing issues
  - Coordinated teams of skilled trades and production personnel under significant pressure caused by the financial impact of lost production time

2003-2005 — Control Systems Engineer and Electrical Designer
ATL Industries
Uxbridge, Ontario

- Conceptualized, designed and implemented innovative electrical and control systems for the automotive and manufacturing industries
  - Collaboratively designed electrical and pneumatic control system and novel industrial communication networks for projects up to $2.5 million
- Supervised onsite installation teams during machine installation and commissioning for multiple projects in North America, such as:
  - Brose Technik full door assembly line, Vance, Alabama

  - ABC Technologies Inc., plastic processing equipment, Gallatin, Tennessee
  - Honda Manufacturing, car battery installation line, Lincoln, Alabama
  - Honda Manufacturing, air pressure decay HVAC test, Aliston, Ontario
- Communicated directly with customers during quoting, contract negotiation, equipment design, equipment testing, installation, training, and service

2002-2003 Electrical Engineer
Delphi Energy and Engine Management Systems
Oshawa, Ontario

- Implemented and supervised entire projects from start to finish, including the design, installation, debugging and training
- Supported manufacturing production with several processes such as:
  - Injection moulding (plastics)
  - Molten lead moulding
  - TIG and Extrusion/Fusion welding
  - Industrial computer vision systems
  - Hazardous material handling
- Maintained existing plant equipment during regular production and assisted with troubleshooting equipment malfunctions
- Supervised both production and maintenance teams as required and when the opportunity was available

3 PRIMARY RESEARCH INTERESTS

- Computer vision human motion tracking and activity detection
- Multi-sensor synthesis and 3D scene reconstruction
- Supporting aging-in-place with assistive technologies for persons with dementia
- Multiple sclerosis rehabilitation and assessment with intelligent technologies

4 PUBLICATION LIST

Publication Type	Pre-2015	2016	2017	Career Total
Peer-Reviewed Journal Articles	3	2	1	6
Peer-Reviewed Conference Papers/Abstracts	15	4	2	21
Peer-Reviewed Conference Proceedings	1	1	4	6
Chapters in Books	1	1	0	2
Reports	0	1	0	1
Non-Peer-Reviewed Articles/Proceedings/Presentations	13	2	0	15

Invited Presentations/Lectures/Keynotes	11	5	2	18
Media Appearances	0	1	0	1

4.1 Peer-Reviewed Journal Articles

[1] E. M. D. Jean-Baptiste, **S. Czarnuch**, A. Mihailidis, "Monte Carlo Algorithm for Factored POMDP-based Assistive System," Journal of Ambient Intelligence and Smart Environments, 2017 (under review).

[2] **S. Czarnuch**, R. Ricciardelli, and A. Mihailidis, "Predicting the role of assistive technologies in the lives of people with dementia using objective care recipient factors," BMC Geriatrics, vol. 16, pp. 1-11, 2016.

[3] **S. Czarnuch** and A. Mihailidis, "Development and evaluation of a hand tracker using depth images captured from an overhead perspective," Disability & Rehabilitation: Assistive Technology, vol. 11, pp. 150-157, 2016.

[4] M. Grzes, J. Hoey, S. Khan, A. Mihailidis, **S. Czarnuch**, D. Jackson, and A. Monk, "Relational approach to knowledge engineering for POMDP-based assistance systems as a translation of a psychological model," International Journal of Approximate Reasoning, vol. 55, pp. 36-58, 2014.

[5] **S. Czarnuch**, S. Cohen, V. Parameswaran, and A. Mihailidis, "A real-world deployment of the COACH prompting system," Journal of Ambient Intelligence and Smart Environments, Thematic Issue on Designing and Deploying Intelligent Environments, vol. 5, pp. 463–478, 2013.

[6] **S. Czarnuch** and A. Mihailidis, "The design of intelligent in-home assistive technologies: Assessing the needs of older adults with dementia and their caregivers," Gerontechnology, vol. 10, pp. 165-178, 2011.

4.2 Peer-Reviewed Conference Papers/Abstracts

Student first-authors *italicized.*

[1] *K. Habib* and **S. Czarnuch**, "State of the art of ground plane detection in 3D applications: A systematic review," presented at the Newfoundland Electrical and Computer Engineering Conference, IEEE, Newfoundland and Labrador Section, St. John's, NL, 2016.

[2] *A. J. R. Hynes* and **S. Czarnuch**, "Building a feature vector for assessing the gait of persons with multiple sclerosis," presented at the Newfoundland Electrical and Computer Engineering Conference, IEEE, Newfoundland and Labrador Section, St. John's, NL, 2016.

[3] *Z. Yang* and **S. Czarnuch**, "3D Point Cloud based Human Skeleton Identification," presented at the Newfoundland Electrical and Computer Engineering Conference, IEEE, Newfoundland and Labrador Section, St. John's, NL, 2015.

[4] M. Ploughman, S. N. Rancourt, L. P. Kelly, G. Grover, E. M. Wallack, S. Granter-Button, D. T. G. Philpott, D. Button, K. Power, and **S. Czarnuch**, "Assessing peak oxygen consumption in peoplewith multiple sclerosis using total body recumbent stepper and weight supported treadmill," presented at the Rehabilitation in MS Annual Conference, Milan, Italy, 2015.

[5] M. Ploughman, S. N. Rancourt, L. P. Kelly, G. Grover, E. M. Wallack, S. Granter-Button, D. T. G. Philpott, D. Button, K. Power, and **S. Czarnuch**, "Reducing post-exercise decrements inperformance in MS: Preliminary Steps," presented at the Rehabilitation in MS Annual Conference, Milan, Italy, 2015.

[6] **S. Czarnuch**, "Automated ground plane detection using human motion and environmental geometry," presented at the Newfoundland Electrical and Computer Engineering Conference, IEEE, Newfoundland and Labrador Section, St. John's, NL, 2015.

[7] *L. Lin*, **S. Czarnuch**, A. Malhotra, C. Yu, and J. Hoey, "Affectively aligned cognitive assistance using Bayesian affect control theory," presented at the 8th International Conference on Ubiquitous Computing & Ambient Intelligence (UCAmI) & 6th International Work-conference on Ambient Assisted Living (IWAAL) Belfast, Ireland, 2014.

[8] **S. Czarnuch** and M. Ploughman, "Automated gait analysis in people with Multiple Sclerosis using two unreferenced depth imaging sensors: Preliminary steps," presented at the Newfoundland Electrical and Computer Engineering Conference, IEEE, Newfoundland and Labrador Section, St. John's, NL, 2014.

[9] **S. Czarnuch** and A. Mihailidis, "Development and evaluation of a hand tracker using depth images captured from an overhead perspective," presented at the Newfoundland Electrical and Computer Engineering Conference, IEEE, Newfoundland and Labrador Section, St. John's, NL, 2014.

[10] R. Wang, P. Viswanathan, **S. Czarnuch**, J. Boger, G. Nejat, and A. Mihailidis, "Developing advanced assistive technologies for older adults with dementia: Lessons learned," presented at the Rehabilitation Engineering and Assistive Technology Society of North America (RESNA), Bellevue, WA, 2013.

[11] R. Ricciardelli, A. Bridgman, **S. Czarnuch**, B. Ye, J. Bell, and A. Mihailidis, "The impact of caregiver socio-demographic factors on assistive technology needs when caring for a person with Alzheimer's disease," presented at the Canadian Association on Gerontology (CAG): Aging...from Cells to Society, Halifax, NS, 2013.

[12] R. Ricciardelli, J. Bell, **S. Czarnuch**, B. Ye, J. Tong, and A. Mihailidis, "The impact of care recipient factors on their assistive technology needs for daily task completion," presented at the Canadian Association on Gerontology (CAG): Aging...from Cells to Society, Halifax, NS, 2013.

[13] *J. Hill*, R. Ricciardelli, **S. Czarnuch**, and A. Mihailidis, "The relationship between perceptions of assistive technology and the ethical and legal concerns relevant to their acceptance and use," presented at the Canadian Association on Gerontology (CAG): Aging...from Cells to Society, Halifax, NS, 2013.

[14] **S. Czarnuch**, R. Ricciardelli, J. Bell, B. Ye, and A. Mihailidis, "Financial realities and occupational strain: Designing accessible, needed, and appropriate Intelligent Assistive Technologies for people with dementia," presented at the Canadian Association on Gerontology (CAG): Aging...from Cells to Society, Halifax, NS, 2013.

[15] **S. Czarnuch** and A. Mihailidis, "An in-home efficacy study of the COACH prompting system," presented at the Canadian Association on Gerontology (CAG): Aging...from Cells to Society, Halifax, NS, 2013.

[16] *A. Bridgman*, **S. Czarnuch**, R. Ricciardelli, and A. Mihailidis, "Linking caregiver's experiences of 'caregiver burden' with their perception of the usefulness of Assistive Technologies when caring for a person with Alzheimer's disease," presented at the Canadian Association on Gerontology (CAG): Aging...from Cells to Society, Halifax, NS, 2013.

[17] **S. Czarnuch** and A. Mihailidis, "The COACH: Assisted Cognition," presented at the Humboldt Colloquium, Toronto, Canada, 2012.

[18] **S. Czarnuch** and A. Mihailidis, "The COACH: A real-world effectiveness study," presented at the Canadian Student Health Research Forum, Winnipeg, Manitoba, 2012.

[19] **S. Czarnuch** and A. Mihailidis, "The COACH: A real-world efficacy study," presented at the Alzheimer's Association International Conference (AAIC), Vancouver, British Columbia, 2012.

[20] **S. Czarnuch** and A. Mihailidis, "The COACH prompting system: Determining and understanding the needs of caregivers and older adults with dementia," presented at the 6th Annual Canadian Conference on Dementia, Montreal, Canada, 2011.

[21] **S. Czarnuch**, J. Boger, and A. Mihailidis, "COACH@Home: An Ambient Assistive Living Technology for People with Dementia," presented at the Festival of International Conferences on Caregiving, Disability, Aging and Technology, Toronto, Ontario, 2011.

4.3 Peer-Reviewed Conference Proceedings

[1] **S. Czarnuch**, "The role of technology as an MS endpoint: Old problems with new perspectives," in Americas Committee for Treatment & Research in Multiple Sclerosis (ACTRIMS), Orlando, FL, 2017.

[2] A. Hynes, and **S. Czarnuch**, "Assessing the gait of people with multiple sclerosis using 3D motion tracking: toward objective outcome measures," in Americas Committee for Treatment & Research in Multiple Sclerosis (ACTRIMS), Orlando, FL, 2017.

[3] Z. Chen, **S. Czarnuch**, A. Smith, and M. Shehata, "Performance evaluation of 3D keypoints and descriptors," in Lecture Notes in Computer Science, Proceedings of the International Symposium on Visual Computing, Las Vegas, NV, 2016.

[4] A. J. R. Hynes and **S. Czarnuch**, "Combinatorial Optimization for Human Body Tracking," in *Lecture Notes in Computer Science, Proceedings of the International Symposium on Visual Computing*, Las Vegas, NV, 2016.

[5] **S. Czarnuch** and M. Ploughman, "Toward inexpensive, autonomous, and unobtrusive exercise therapy support for persons with MS," in Americas Committee for Treatment & Research in Multiple Sclerosis (ACTRIMS), New Orleans, LA, 2016.

[6] M. Grzes, J. Hoey, S. Khan, A. Mihailidis, **S. Czarnuch**, D. Jackson, and A. F. Monk, "Relational Approach to Knowledge Engineering for POMDP-based Assistance Systems with Encoding of a Psychological Model," in Proceedings of the ICAPS 2011 Workshop on Knowledge Engineering for Planning and Scheduling (KEPS), Freiburg, Germany, 2011.

4.4 Chapters in Books

[1] R. Ricciardelli and **S. Czarnuch**, "Surviving parenthood in academia: Two professionals striving to maintain work life balance," in The parent-track: Timing, balance and choice within academia, E. Berger and C. DeRoche, Eds., Waterloo: Wilfred Laurier Press, 2016.

[2] A. Mihailidis, J. Boger, **S. Czarnuch**, T. Nagdee, and J. Hoey, "Ambient Assisted Living Technology to Support Older Adults with Dementia with Activities of Daily Living: Key Concepts and the State of the Art," in Handbook of Ambient Assisted Living - Technology for Healthcare, Rehabilitation and Well-being, J. C. Augusto, M. Huch, A. Kameas, J. Maitland, P. McCullagh, J. Roberts, A. Sixsmith, and R. Wichert, Eds., ed Amsterdam, The Netherlands: IOS Press, 2012, pp. 304 - 330.

4.5 Reports

[1] **S. Czarnuch**, R. Ricciardelli, B. Ye, and A. Mihailidis, "Moving toward a user-centred design: Assistive technology for older adults with dementia," Alzheimer Society of Canada, Ottawa, ON, 2015.

4.6 Non-Peer-Reviewed Articles/Proceedings/Presentations

[1] **S. Czarnuch**, J. Connolly, and C. Maddox, "MS Society of Canada, Avalon Chapter annual newsletter," ed. St. John's, Canada, 2016.

[2] R. Ricciardelli and **S. Czarnuch**. (2013) Moving into milestones... with multiples. Multiple Moments Quarterly: Multiple Births Canada. 16-18.

[3] **S. Czarnuch** and A. Mihailidis, "The COACH: An automated daily task support for older adults with dementia," presented at the Toronto Rehab's 9th Annual Research Day, Toronto, Canada, 2013.

[4] **S. Czarnuch** and A. Mihailidis, "A community-based efficacy study of the COACH," presented at the IBBME Scientific Day, Toronto, Canada, 2012.

[5] A. Mihailidis and **S. Czarnuch**, "Towards a Pervasive Prompting System: Improving and Expanding the COACH," presented at the 7th Annual Every Day Technologies for Alzheimer's Care (ETAC) symposium, Toronto, ON, 2011.

[6] A. Hwang, K. Truong, **S. Czarnuch**, and A. Mihailidis, "Bringing C.O.A.C.H. one step closer to the home: Designing a computer-based tool for dementia caregivers," presented at the Toronto Rehab's 7th Annual Research Day, Toronto, Canada, 2011.

[7] M. Grzes, J. Hoey, K. Shehroz, A. Mihailidis, **S. Czarnuch**, D. Jackson, and A. Monk, "Relational Approach to Knowledge Engineering for POMDP-based Assistance Systems with Encoding of a Psychological Model," presented at the Toronto Rehab's 7th Annual Research Day, Toronto, Canada, 2011.

[8] **S. Czarnuch**, A. Mihailidis, and J. Boger, "Determining Technical Design Criteria for the COACH Prompting System," presented at the Toronto Rehab's 7th Annual Research Day, Toronto, Canada, 2011.

[9] **S. Czarnuch**, J. Boger, and A. Mihailidis, "Supporting Older Adults with Dementia with Ambient Assistive Living Technology," presented at the IBBME Scientific Day, Toronto, Ontario, 2011.

[10] **S. Czarnuch**, J. Boger, and A. Mihailidis, "COACH@Home: Participatory Design of AT for People with Dementia," presented at the Caregiving Best Practices Day, Toronto, Ontario, 2011.

[11] **S. Czarnuch**. (2011) Challenges in caring. Multiple Moments. 12.

[12] **S. Czarnuch**, "CARE Trainee Profile," Institute for Biomaterials and Biomedical Engineering, University of Toronto, Toronto, 2011.

[13] **S. Czarnuch**, J. Boger, and A. Mihailidis, "Prompting older adults with dementia through tasks with the COACH," presented at the Toronto Rehab's 6th Annual Research Day, Toronto, Canada, 2010.

[14] A. Mihailidis and **S. Czarnuch**, "Towards a Pervasive Prompting System: Improving and Expanding the COACH," presented at the 5th Annual Every Day Technologies for Alzheimer's Care (ETAC) symposium, Portland & Hillsboro, OR., 2009.

[15] **S. Czarnuch**, K. Zagorovsky, P. Tang, N. Wu, and A. Posatskiy, "A Tool For Rudimentary Self-Screening of Diabetic Retinopathy and Related Disorders," presented at the BME1450 Poster session, 2009.

4.7 Invited Presentations/Lectures/Keynotes

[1] S. Czarnuch, "The medicalization of deviance, disability, aging and technology," in Guest lecture in the Faculty of Humanities and Social Sciences, department of Sociology at Memorial University, ed. St. John's, NL, 2016.

[2] **S. Czarnuch**, "Enhancing rehabilitation in MS with pervasive technology," in Avalon MS Society chapter meeting, ed. St. John's, NL, 2016.

[3] **S. Czarnuch**, "Perspectives on work-life balance: Can it be achieved in academic research?," in Toronto Rehabilitation Institute/University of Toronto, ed. Toronto, Ontario, 2016.

[4] **S. Czarnuch**, "Intelligent technologies: Supporting persons with MS," in Avalon MS Society chapter meeting, ed. St. John's, NL, 2015.

[5] **S. Czarnuch**, "Pervasive technology for healthcare: Supporting an aging population," in Invited presentation at the Newfoundland and Labrador Centre for Applied Health Research, Research Group on Aging, ed. St. John's, NL, 2015.

[6] **S. Czarnuch**, "Biomedical Engineering," in Speaker series lecture conducted at the Faculty of Engineering and Applied Science, Memorial University, ed. St. John's, NL, 2015.

[7] **S. Czarnuch**, "Enhancing rehabilitation in MS," in Invited presentation at the Atlantic endMS 2014 MS Research Retreat, ed. Halifax, NS, 2014.

[8] **S. Czarnuch** and J. G. Bell, "Toward Developing an Assistive Technology Framework for Older Adults with Dementia: A User-Centred Design Approach," in Invited presentation at the Alzheimer Society of Niagara Region, ed. St. Catherines, Ontario, 2013.

[9] **S. Czarnuch**, "Activity tracking from an overhead depth camera: From joint proposals to a skeleton model," in Speaker series lecture conducted at the Department of Computer Science. Memorial University, ed. St. John's. NL, 2013.

[10] A. Mihailidis and **S. Czarnuch**, "Innovations in technology to support people with Alzheimer's disease," in Invited presentation at the Toronto Memory Program, ed. Toronto, ON, 2012.

[11] **S. Czarnuch** and A. Arcelus, "Smart Home Technologies and Artificial Intelligence: Applications to Older Adults," in Invited lecture on Artificial Intelligence for the Da Vinci Engineering Enrichment (DEEP) program, University of Toronto, ed. Toronto, Ontario, 2012.

[12] **S. Czarnuch**, "The COACH prompting system," in Invited presentation at the Southlake Regional Health Centre, ed. Newmarket, ON, 2012.

[13] **S. Czarnuch**, "Technology and an aging population," in Guest lecture in the Faculty of Liberal Arts and Professional Studies, department of Sociology at York University, ed. North York, ON, 2011.

[14] **S. Czarnuch**, "Assistive technology: The future of health and health care?," in Guest lecture in the Faculty of Health Sciences, department of Sociology at York University, ed. North York, ON, 2010.

[15] **S. Czarnuch**, "Towards a pervasive prompting system for older adults with dementia: Improving and expanding the COACH," in Invited presentation at the West Hill Community Services Centre, ed. Toronto, ON, 2010.

[16] **S. Czarnuch**, "Introduction to research methodologies," in Guest lecture in the Faculty of Criminology, Justice and Policy Studies at the University of Ontario Institute of Technology, ed. Oshawa, ON, 2009.

[17] **S. Czarnuch**, "Exploring interdisciplinary research methodologies," in Guest lecture in the Faculty of Arts, department of Sociology at Trent University, ed. Peterborough, ON, 2009.

4.8 Media Appearances

[1] K. Breen, "Engineers give man technology to compete in boccia," in NTV News, ed. St. John's, NL, 2015, http://ntv.ca/engineers-give-man-technology-to-compete-in-boccia/.

4.9 Dissertations and Theses

[1] **S. Czarnuch**, "Advancing the COACH automated prompting system toward an unsupervised, real-world deployment," Doctor of Philosophy, Institute of Biomaterials and Biomedical Engineering, University of Toronto, Toronto, 2014.

[2] **S. Czarnuch**, "Interbar Currents in Rotating Stator Induction Machines," M.A.Sc., Electrical and Computer Engineering, McMaster University, Hamilton, Ontario, Canada, 2005.

4.10 Manuscripts in Preparation

[1] Z. Chen, S. Czarnuch & M. Shehata, "3D Hand Tracking using Multiple RGB-D Sensors".

[2] A. Hynes and S. Czarnuch, "Graph theory and Dijkstra's shortest path: four limb skeleton modelling optimization".

[3] S. Czarnuch. & A. Mihailidis, "Overhead hand, grip and arm tracking using skeleton models".

[4] S. Czarnuch, R. Ricciardelli, and A. Mihailidis, "Culture, ethnicity, and race: Impacting caregiver use of assistive technology for cognition".

[5] S. Czarnuch, R. Ricciardelli, and A. Mihailidis, "The predictive efficacy of objective carer factors: Helping persons with dementia by understanding their needs".

5 RESEARCH FUNDING

5.1 Funding Received or Under Review

Year	Grantor; Type; Title; Investigators	Role	Status	Amount
2016	Memorial University, Seed, Bridge and Multidisciplinary Fund; *Exploring factors*	PI	Awarded	$9,776.16

	affecting participation in home exercise therapies for persons with multiple sclerosis: A needs assessment, S. Czarnuch.			
2016	NSERC; Discovery Grant; *Human motion tracking-by-detection using point cloud data from multiple depth sensors*; S. Czarnuch.	PI	Awarded	$145,000
2016	Canadian Foundation for Innovation (CFI); *Computer-Aided Design Laboratory for Analog and Mixed-Signal VLSI Systems*; L. Zhang (PI) and H. Heys (PI), S. Czarnuch.	Collaborator	Awarded	$91,756
2015	Memorial University; Faculties of Engineering and Applied Science and Medicine Start-up funds; *Human Motion Tracking and Automated Planning*; S. Czarnuch	PI	Awarded	$50,000
2014-2017	Multiple Sclerosis Society of Canada; Post-doctoral fellowship; *Toward automated rehabilitation support and progress assessment for people with Multiple Sclerosis: Improving recovery, objectivity and safety with technology*; S. Czarnuch	PI	Awarded	$117,000
2012-2014	Alzheimer Society of Canada; Alzheimer Society Research Program; *Toward developing an assistive technology framework for older adults with dementia: A user-centred design approach*; A. Mihailidis, R. Ricciardelli, S. Czarnuch, T. Nagdee	Collaborator	Awarded	$118,040

5.2 Unsuccessful Funding Applications

Year	Grantor; Type; Title; Investigators	Role	Amount
2016	SSHRC; Connection Grant; *Post-Traumatic Stress Disorder: A Multidisciplinary Conference on Causes, Consequences and Responses*; R. Ricciardelli, S. Czarnuch and S. Bornstein	Co-Investigator	$ 24,135
2016	CIHR; CIHR Project Scheme; *Quantifying disease progression in persons with multiple sclerosis using unobtrusive, three-dimensional full-body gait analysis*; S. Czarnuch.	PI	$170,000
2016	Memorial University Faculty of Medicine; Dean's Innovation Fund; *Improving the evaluation of treatment*	PI	$19,985

	efficacy and disease progression in multiple sclerosis using automated full-body gait analysis; S. Czarnuch.		
2015	Memorial University; Seed, Bridge and Multidisciplinary Fund; *International Extension of an Assistive Technology Framework for Older Adults with Dementia: A Pilot Study*; S. Czarnuch, R. Ricciardelli, L. Swiss.	PI	$9776
2015 (fall)	Multiple Sclerosis Society of Canada; Clinical and Population Health Research Operating Grant; *Automated rehabilitation support and assessment for people with Multiple Sclerosis: Improving recovery, objectivity and safety with intelligent technology*; S. Czarnuch, M. Ploughman, R. Ricciardelli	PI	$116,462
2015 (spring)	Multiple Sclerosis Society of Canada; Clinical and Population Health Research Operating Grant; *Automated rehabilitation support and assessment for people with Multiple Sclerosis: Improving recovery, objectivity and safety with intelligent technology*; S. Czarnuch, M. Ploughman, R. Ricciardelli	PI	$269,771
2015	Memorial University; Seed, Bridge and Multidisciplinary Fund; *Toward Developing an Assistive Technology Framework for Older Adults with Dementia: A User-Centred Design Approach*; Stephen Czarnuch, Rosemary Ricciardelli, Liam Swiss	PI	$9979.83
2015	CIHR; Strategy for Patient-Oriented Research (SPOR), *GoMobile with Clear*, P.Wang et al., S. Czarnuch	Collaborator	N/A
2014	Multiple Sclerosis Society of Canada; Clinical and Population Health Research Operating Grant; M. Ploughman, C. Moore, K. Power, D. Button, S. Czarnuch, M. Stefanelli	Collaborator	$300,000
2014	Newfoundland and Labrador Centre for Applied Health Research; Project Grant; *Automated fatigue detection in people with MS: Improving the safety and efficacy of rehabilitation exercise*; Stephen Czarnuch, Michelle Ploughman, Diane Cook	PI	$22,068

6 AWARDS AND FUNDING

Year	Award Title	Organization	Amount

2016	Best Paper Award	Newfoundland Electrical and Computer Engineering Conference, IEEE, Newfoundland and Labrador Section	$0
2016	Young Investigator Award: Educational Grant	Americas Committee for Treatment & Research in Multiple Sclerosis (ACTRIMS)	$600 USD
2014	Doctoral Completion Award	Institute of Biomaterials and Biomedical Engineering, University of Toronto	$5,000
2014	Best Paper award: Engineering in a Clinical Setting	Institute of Biomaterials and Biomedical Engineering, University of Toronto	$250
2013	Travel Fellowship	Annual General Meeting of the Canadian Association on Gerontology	$250
2012	Travel Fellowship	Alzheimer's Association International Conference	$2,500
2012	Travel Fellowship	CIHR Canadian Student Health Research Forum	$1,000
2011-2012	Research Assistant Stipend	CIHR/Alzheimer's Association	$17,500
2011-2012	University of Toronto Fellowship	Institute of Biomaterials and Biomedical Engineering	$2,000
2010-2012	NSERC CREATE: Care Scholarship	NSERC/University of Toronto	$39,000
2010-2011	Research Assistant Stipend	CIHR/Alzheimer's Association	$15,000
2009-2010	Research Assistant Stipend	CIHR/Alzheimer's Association	$15,000
2009-2010	University of Toronto Fellowship	Institute of Biomaterials and Biomedical Engineering	$10,000
2009-2010	Barbara and Frank Milligan Fellowship	University of Toronto	$3,000
2002-2004	Graduate Student Scholarship	McMaster University	$24,000
2000	Millennium Bursary	Canada Millennium Scholarship Foundation	$3,000
1999	Ontario Student Opportunity Grant	Ministry of Training, Colleges and Universities	$459

7 SCHOLARLY AND PROFESSIONAL ACTIVITIES

7.1 Teaching

7.1.1 Courses Taught at Memorial University

Year	Course No.	Level	Course Name	Institution
2017	ENGI 8853	Undergraduate	Computer Engineering project course II	Memorial University
2017	ENGI 8103	Undergraduate	Engineering in Medicine	Memorial University
2016	ENGI 7803	Undergraduate	Computer Engineering project course I	Memorial University
2016	ENGI 8103	Undergraduate	Engineering in Medicine	Memorial University
2015	ENGI 8853	Undergraduate	Computer Engineering project course II	Memorial University
2015	ENGI 7804	Undergraduate	Computer Engineering project course I	Memorial University
2014	ENGI 7894/ 9869	Undergraduate/ Graduate	Concurrent programming	Memorial University
2012	DEEP	High-school	Da Vinci Engineering Enrichment Program	University of Toronto

7.2 Supervisory Activities

7.2.1 M.Eng. (Thesis) Students

Start Year	Role	Status	Student	Project Title
2016	Supervisor	In progress	Hynes, A. J. R.	Combinatorial optimization for human body tracking
2014	Co-supervisor	In progress	Chen, Z.	Automatic evaluation of ultrasound operators' skill

7.2.2 M.A.Sc. (Coursework) Students

Year	Course	Status	Student	Project Title

2016	ENGI 980A/980B	In progress	Tian, Y.	Finger Joint Detection for Clinical Practice
2015	ENGI 980A/980B	Completed	Yang, Z.	Human motion tracking-by-detection using point cloud data from multiple depth sensors

7.2.3 Undergraduate Research Project Supervision

Year	Course	Status	Students	Project Title
2016	ENGI 7804/8854	In progress	George, M., Pratt, C., Seymour, R.	Precise point
2016	ENGI 7804/8854	In progress	Beazley, M., Bennett, T., Murrin, H., Power, M., Ryan, C.	Kloud 9: Automated multi-sensor ground plane detection and depth calibration
2015	ENGI 7804/8854	Completed	Bonnell, A., Chaytor, S., Randell, A, Wicks, J.	Wearable Integrated Safety Alarm and Locator (WISAL)
2015	ENGI 7804/8854	Completed	Davis, M., Nugent, S., Rodgers, J., Stevens, T.	Vision-impaired emblem warning system (VIEWS)
2014	ENGI 7926/8926	Completed	Ellwood, D., Mandke, U., McGrath, B., Williams, M.	An improved ramp and pointer for Boccia Ball players with cerebral palsy
2014	HKR 4610	Completed	Abbot, C., Buckle, N., Holloway, B., Lockyer, E.,	Creation of a dual-task, metronome-timed bipedal hop test: A sensitive and reliable measure for mild Multiple Sclerosis

7.2.4 Medical Student Research Phase Mentoring

Year	Research Phase	Status	Student	Project Title
2016	Phase 2	In progress	Krustev, E.	Assessing Abnormal Gait in Patients with Multiple Sclerosis
2016	Phase 2	In progress	Ballouk, H.	Intelligent Technologies that can Assist Seniors with Dementia to Age at Home
2015	Phase 1	Completed	Krustev, E.	Assessing Abnormal Gait in Patients with Multiple Sclerosis: A Review

2015	Phase 1	Completed	Ballouk, H.	Survey of Intelligent Technologies that can Assist Seniors with Dementia to Age at Home
2015	Phase 1	Completed	Vessey, C.	Prosthetics for Dancers with Transtibial Amputations: A literature review

7.2.5 Research Assistant Supervision

Period	Name	Education	Hiring/Training objective
September, 2016 – present	Andres, E.	M.A	Further development of skills to support transition from graduate school to industry
August, 2016 – December, 2016	Habib, K.	M. Eng.	Exploration of biomedical engineering in consideration of graduate studies (PhD)
September, 2016 – December, 2016	Rahimi, A.	M. Sc.	Further development of skills to support transition from graduate school to industry
September, 2016 – December, 2016	Crichton, H.	M. A.	Expansion and evaluation of qualitative skills into health and healthcare
September, 2016 – December, 2016	Mooney, T.	B. A.	No specific training objectives for this project
August, 2016 – present	Fathi, P.	B. Eng.	Exploration of biomedical engineering in consideration of graduate studies (M.A.Sc.)
June - July, 2016	Chen, Z.	B. Eng.	No specific training objectives for this project
June 2014 – May, 2015	Tong, J.	M.Sc.	No specific training objectives for this project

7.3 Assessment and Review Activities

7.3.1 Graduate Examination Activities

Date	Activity	Role	Level	Student
2016	Thesis submission and Defense	Internal Examiner	PhD	Dion Hicks
2016	Thesis submission and Defense	Internal Examiner	PhD	Amir Tahavorgar
2016	Comprehensive examination	Chair	PhD	Muamer Shebani
2016	Comprehensive examination	Chair	PhD	Murtada Abdein El-Haj
2016	Comprehensive examination	Chair	PhD	Khalifa Alrbee
2016	Thesis submission	Internal Examiner	M.Eng.	Abdelrahman Ahmed

2015	Thesis submission and Defense	Internal Examiner	PhD	Javier Ortiz Castro
2015	Comprehensive examination	Chair	PhD	Swapna Puthukkudi Chalil
2015	Comprehensive examination	Chair	PhD	Suhad Sbeih

7.3.2 Journal Reviewer

Journal	Year(s)	Role
Newfoundland Electrical and Computer Engineering Conference, IEEE, Newfoundland and Labrador Section	2016	Invited Reviewer
Journal of Ambient Intelligence and Smart Environments (JAISE)	2015, 2016	Invited Reviewer
PLOS ONE	2015	Invited Reviewer
Newfoundland Electrical and Computer Engineering Conference, IEEE, Newfoundland and Labrador Section	2015	Invited Reviewer
IEEE 23rd Annual Newfoundland Electrical and Computer Engineering Conference	2014	Invited Reviewer
IEEE Transactions on Human-Machine Systems	2014	Invited Reviewer
Newfoundland Electrical and Computer Engineering Conference, IEEE, Newfoundland and Labrador Section	2014	Invited Reviewer
International Conference on Pervasive Computing Technologies for Healthcare	2012	Invited Reviewer
IEEE Transactions on Mechatronics	2010, 2011	Invited Reviewer
RESNA Annual Conference	2009	Invited Reviewer

7.3.3 Roles in Major Conferences

Conference	Date	Role
National Falls Prevention	2017 (April)	Advisory Committee
Newfoundland Electrical and Computer Engineering Conference, IEEE, Newfoundland and Labrador Section	2015 (November)	Session Chair – Controls & Instrumentation II

Newfoundland Electrical and Computer Engineering Conference, IEEE, Newfoundland and Labrador Section	2015 (November)	Session Chair – Power
PervasiveHealth 2016	2016	Programme Committee
Newfoundland Electrical and Computer Engineering Conference, IEEE, Newfoundland and Labrador Section	2015 (November)	Session Chair – Biomedical
Newfoundland Electrical and Computer Engineering Conference, IEEE, Newfoundland and Labrador Section	2015 (November)	Session Chair – Communication and Networking
Newfoundland Electrical and Computer Engineering Conference, IEEE, NL Section	2014 (November)	Session Chair – Computer Vision
Toronto Rehab's 9th Annual Research Day	2013 (November)	Student poster competition judge

7.4 Academic Service

Committee	Year	Role
Multiple Sclerosis Society of Canada, endMS Summer School Review Committee	2017	Scientific Reviewer
Multiple Sclerosis Society of Canada, Personnel Awards Review Committee	2016 – 2017	Scientific Reviewer
Electrical and Computer Engineering undergraduate curriculum committee	2016 - present	Member
Electrical and Computer Engineering department head search committee	2016	Member
Faculty of Engineering and Applied Science Program Review Committee – Design Courses	2016	Chair and member

7.5 Community Service

Organization; Contribution	Year	Role
MS Society of Canada, Avalon Chapter; annual newsletter	2016 - present	Editor

7.6 Research Groups

Organization, Group	Year(s)	Role

Social Sciences and Humanities Council (SSHRC) Centre for Research on Work Disability Policy (CRWDP), Disability Inclusion Group (DIG-MUN)	2015 – present	Member
Newfoundland and Labrador Centre for Applied Health Research, Research Exchange Group on Aging	2015 - present	Member

7.7 Memberships in Academic, Community and Professional Societies

Status	Year(s)	Organization
Active	2015 – present	Professional Engineers and Geoscientists of Newfoundland and Labrador (PEGNL) Member #08233
Active	2014 – present	Tetra Society of North America
Active	2010 – present	Alzheimer's Association International Society to Advance Alzheimer Research and Treatment (ISTAART)
Inactive	2009 – 2014	Rehabilitation Engineering and Assistive Technology Society of North America (RESNA)
Inactive	2013 – 2015	Canadian Association on Gerontology (CAG)
Inactive	2014 – 2015	IEEE Student Member #93214255

8 PROFESSIONAL DEVELOPMENT

Year	Course Title	Institution
2015	Problem-Based Learning	Memorial University
2014	Teaching Skills Enhancement Program (TSEP)	Memorial University

9 ACREDITATIONS AND ACCOMPLISHMENTS

- Graduated from PhD (2014) with 4.0 GPA (Note: The University of Toronto does not provide distinction for graduate students)
- Graduated Summa Cum Laude from Masters Degree (2005) with 4.0 GPA
- Graduated Summa Cum Laude from Undergraduate Degree (2002) with 3.7 GPA
- Deans Honour List (1998-2002)
- Good Citizen Award (1998, 1999)
- Golden Key Honour Society Member (1998)