WPI Mathematical Sciences Grants and Awards 2016-2017

2016 – 2017

Data Analysis for Graphene Based Chemical Sensors

U.S. Army NSRDEC

Paffenroth, R.

2016-2019 Amount: $169,682

Robust PCA for Adaptive Resource Management Enabling Deception project with BBN/Raytheon

DARPA

Paffenroth, R.,

$50,000, 2017-2018 and $55,800 2018-2019

Adaptive Resource Management Enabling Deception (ARMED), Extreme DDoS (Distributed Denial of Service) Defense (XD3)

Raytheon BBN Technologies

Paffenroth, R.

2017

The ARMED project is developing techniques to protect service enclaves from extreme distributed denial of service (DDOS) attacks. These attacks may abuse flaws and ill-specified aspects of the network stack running at the service's endpoint. Usually, these attacks are not detected until it is too late, and the core mathematical tools leveraged in this project include robust techniques for linear and non-linear dimension reduction. Under this award, Dr. Paffenroth will investigate the concept of augmenting the usual protocol processing with additional data collection, analysis, and response capabilities, with a focus on anomaly detection.

New Mathematical Methods for Fracture Evolution

National Science Foundation

Larsen, C.

2016-2019

This research project concerns fundamental mathematical questions in fracture mechanics, an area of importance in materials and structural engineering. Despite substantial recent progress in mathematical analysis of models for fracture and crack propagation, nucleation and propagation of material defects in general, and fracture in particular, remain poorly understood, yet their accurate prediction is of great importance in many materials science applications. This project aims to develop new mathematical methods for addressing some of the major challenges in this area. These include showing existence of solutions to classes of mathematical models for fracture evolution, improving dynamic fracture models, and analyzing properties of dynamic fracture solutions, with a particular emphasis on exploring crack branching and its consequences.

Showing existence of quasi-static cohesive fracture evolutions, showing existence for mathematical models of dynamic fracture, and establishing qualitative properties of dynamic fracture solutions are major challenges in the mathematical analysis of fracture mechanics. The methods that have been used to show existence for quasi-static Griffith evolutions are now known to fail for cohesive fracture. The main difficulty arises from the delicate role that history plays in the definition of these solutions. This project will continue the development of new methods for analyzing this and other quasi-static problems, based on higher order energy approximations using history at only a finite number of prior times. Dynamic Griffith fracture is also very delicate, due to complex interactions between elastic singularities and the (a priori unknown) evolving crack set. New methods based on blow-up techniques will be developed for analyzing these evolutions. Learn more about the award.