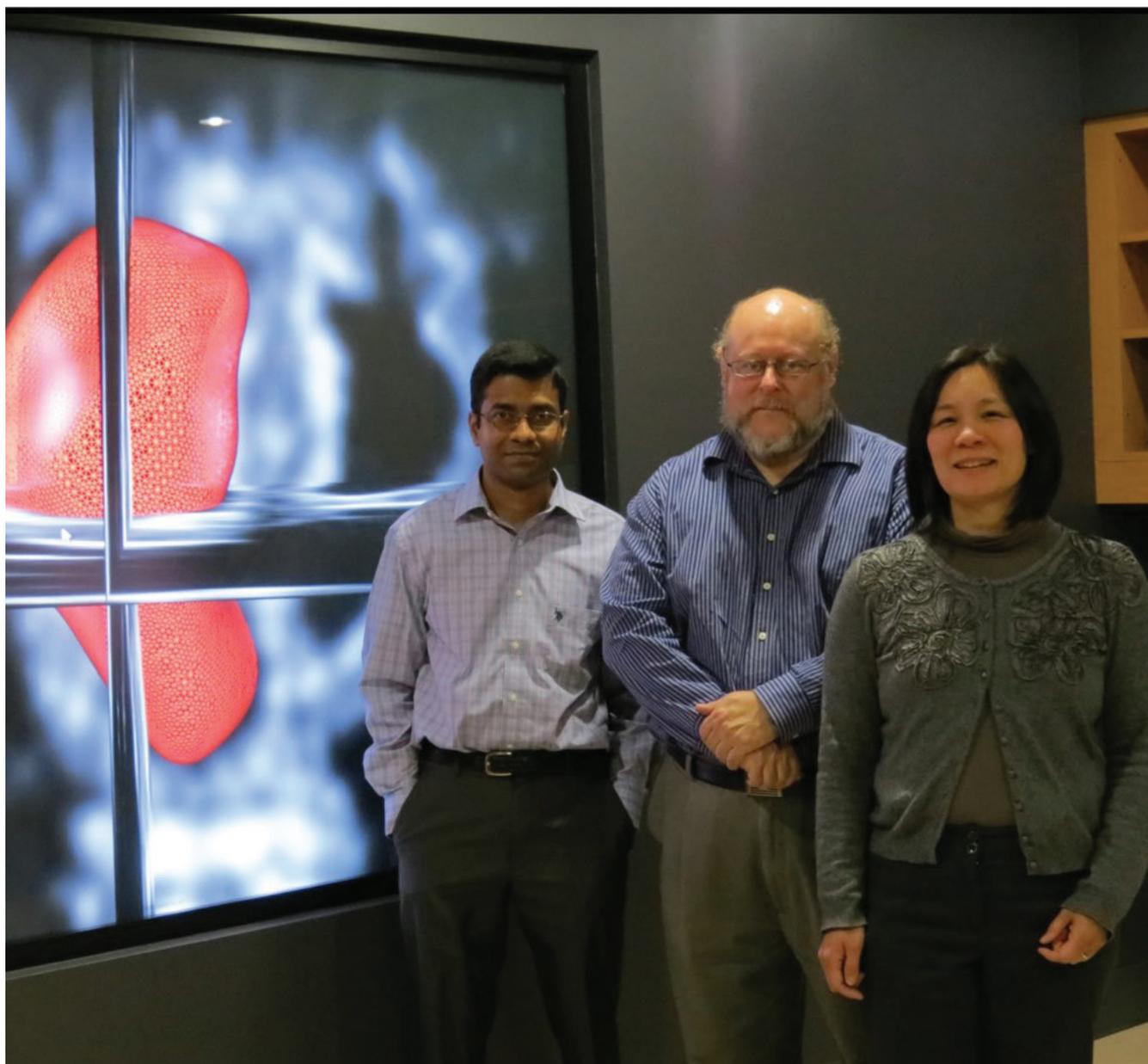# CISCO CHAIR IN HEALTHCARE SOLUTIONS

Dr. Pierre Boulanger, Faculty of Science

UNIVERSITY OF ALBERTA

Research Summary

In 2013, Dr. Pierre Boulanger was awarded the CISCO Chair in healthcare solution, a $2M, 10-year investment by CISCO Systems in the development of new IT technologies for healthcare in Canada.

Many Canadians benefit daily from information technology's enhancement of healthcare delivery and improvement in quality of life. Although these advances are significant, the potential of this field is enormous, and implementation of new technologies has barely begun. This field has much to offer with regards to both cost-effectiveness and quality of future healthcare. High-level collaborative and inter-disciplinary research teams comprised of computer scientists, engineers, social and behavioural scientists, and medical professionals are necessary for this area to progress. The Cisco Chair in Health Solutions focuses on four primary research objectives: medicine for everyone (MedROAD Project); virtual treatment planning and training; networked collaborative systems; and commercialization of research.

Research Progress

Boulanger and his research team continued to deploy the MedROAD V1.0 system (150 installations) over the past year in collaboration with Dr. Raj Padwal, the UofA's Canada Research Chair in Hypertension. Using the MedROAD V1.0 system, the project consisted of telemonitoring at-home blood pressure (BP) of patients after a cerebrovascular event. One of the objectives was to determine the lifetime incremental cost-effectiveness of telemonitoring and case management versus usual normal care for patients with prior cerebrovascular disease. This three-year project was financed by a $1.5M grant from Canadian Institutes of Health Research, ending in December 2018. Results thus far show that home BP telemonitoring and pharmacist case management post-stroke lowered costs and improved quality-adjusted life years. Strategies and funding for broad implementation of this dominant strategy is now being explored.

Also over the past year, the research team continued to develop a new version of MedROAD V2.0. New functionalities include the ability to teleconference with patients and healthcare providers using CISCO Spark technology, the addition of home-care monitoring technologies, and more advanced automated data analysis using machine learning. This version was developed in collaboration with the University of Calgary and Alberta Health Services (AHS) through the Complex Care Hub (CCH), a new initiative. As an alternative to conventional inpatient admission, CCH's goal is to enable patients with low acuity issues requiring hospital-level interventions to receive care at home. This is a partnership between Rockyview General Hospital acute medical services, AHS, Community Paramedics, Home Care, and

Figure 1: New MedROAD V 2.0 System

Boulanger's research work is recognized around the world. He has published more than 340 scientific papers and has patented 12 new concepts, including the Multiview ultrasound probe, which may revolutionize the field of medical imaging by replacing expensive imaging sensors like CT and MRI during cardiac procedures. In addition to the CISCO chair, Boulanger procured financing from numerous granting agencies, including CIHR, NSERC, CFN, Royal Alexandra Hospital, Alberta Innovates, and the Ward of the 21 Century.

Boulanger serves on the editorial board of three major academic computer science journals and is an imaging reviewer for medical journals. He was also the general chair of the AI/GI/CRV 2017, the premier Canadian conference in artificial intelligence, computer graphics, and computer vision.

Boulanger is president of PROTEUS Consulting Inc., a Canadian-based consulting firm specializing in visual simulation applications. He is also the Chief Technology Officer of MedROAD Inc., dedicated to use advanced technology solutions to enhance the health and quality of life of a worldwide clientele and to commercialize the CISCO chair IP.

Figure 2: MedREVIEW System

Transition Services. The updated MedROAD V2.0 will be used to develop services that will reduce the hospitalization of seniors, given their increased risk of complications, morbidity, and mortality in hospital. MedROAD V2.0 design objectives are:

- Improve medication adherence of patients

- Increase ability of patients to self-monitor

- Increase diagnostic tools available to community paramedics

- Increase connectivity between doctors, paramedics, and patients

MedROAD V2.0 is currently being tested by the team members of CCH to validate its functionality and usability before deployment in 2019.

Networked Collaborative Systems for Consultation, Surgical Planning, Postoperative Evaluation, and Education

The importance of information acquisition, in addition to acquiring data at an increased speed and spatial precision, is to make patient-specific models quickly available to, and usable by, specialists who may be at different locations in the operating room, the hospital, or across the country. MedREVIEW, a project started in 2017, is a broad organizational, ongoing collaboration with CISCO Systems to develop immersive visualization/communication solutions applying to patient privacy and the limitations for patients, GPs and specialists in remote locations (rural Alberta, airports, and other countries). This system is currently being prototyped and will be tested in 2018-19 (See Figure 2).

Work on MedBIKE—the continuous patient tele-monitoring for cardiac rehabilitation—is ongoing. A clinical study of system's applications is scheduled for 2019.

Research Plans 2018-2019

Medicine for all: The MedROAD Project

As the hypertension telemonitoring project is concluding, Boulanger and his researchers are now analyzing the data collected during this pilot project to evaluate the impact of MedROAD technology from technical, medical, and economical perspectives.

Following the 2016 pilot project with Whitehorn Home Care and AHS, it became clear that the primary market for the MedROAD technology was aged-care monitoring. Canada's aging population is exploding, with over nine million baby boomers retiring in the next decade and a current demographic of more people aged 65+ than under the age of 15. The Canadian healthcare industry and government must take drastic measures to meet the future's ever-growing and complex healthcare demands. To help the elderly population remain in their homes, we will need new monitoring systems able to measure not only vital signs, but also lifestyle, which includes fall detection, exercise levels, diet, and living conditions. Using this monitoring system, families, private aged care services,

and government will be able to take better care of their aging parents and constituents, reduce hospitalization, and decrease the need for aged-care facilities. The research team is continuing to re-engineer MedROAD in 2018-19, taking into account these new specifications. The system will be tested in real-world situations with CCH medical partners.

This summer (2018), Boulanger and his team are also developing a new version of MedBIKE for a monitored spin class where participants will be able to explore together a virtual world and simultaneously be monitored to evaluate physical performance. Their goal is to deploy a system at the Glenn Sather Sports Medicine Clinic and at the YMCA in 2019.

From Medical Imaging to Virtual Treatment Planning and Training

Boulanger and his team are continuing to work on Multiview ultrasound imaging; a clinical prototype system will be built by the end of summer 2018. This prototype will be deployed for clinical testing in autumn 2018. Work on sensor fusion, surgical planning, and immersive visualization at SVCC is also ongoing. Finally, plans are in

place to deploy surgical planning review displays compatible with operating room conditions that can be used for image-guided surgery.

Networked Collaborative Systems for Consultation, Surgical Planning, Postoperative Evaluation, and Education

In collaboration with CISCO system and SVCC, the research team is developing a new networked visualization system based on VR headsets that can display patient-specific models over the network for collaborative diagnostics and surgical planning.

The team is also continuing to develop a new system based on an instrumented vest called Hexoskin to monitor physical activity (e.g. step count, fall, heart rate, temperature, breathing). Hexoskin will provide valuable information to therapists on how patients recover in their homes after a hospital stay. This project—MedMONITOR, initiated in May 2017—is in collaboration with physiotherapists at the Canmore General Hospital and the Calgary Falls Prevention Clinic.

UNIVERSITY OF ALBERTA