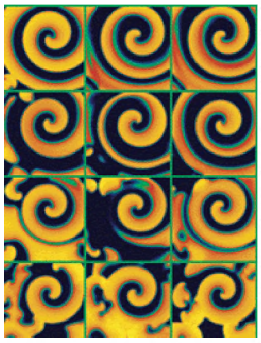
# College researchers part of $10 million NSF grant



*As part of the study, Cornell investigators will analyze fibrillation onset in cardiac tissue*

Two Cornell researchers at the College of Veterinary Medicine are part of a 19-investigator team that was awarded $10 million under the prestigious Expeditions in Computing program of the National Science Foundation. Under the five-year grant, investigators from eight institutions will be helping to develop and apply the next generation of model checking and abstract interpretation. The investigators will use these computational tools to address challenging problems in complex biological and embedded systems. Four issues will be investigated with support from this multi-disciplinary, multi-institution grant: mechanisms of atrial fibrillation, inter-cellular signaling in pancreatic cancer and the control systems embedded in automobiles and aircraft.

Cornell researchers Dr. Flavio H. Fenton, Research Associate, and Dr. Robert F. Gilmour, Jr., Professor and Associate Dean for Research and Graduate Education, have teamed with three faculty at Stony Brook University to investigate atrial fibrillation, the most common form of heart rhythm disturbance. Across the world, 30 percent of all deaths are attributed to cardiovascular disease (CVD). Every 37 seconds, an American dies from heart failure, and the World Health Organization predicts 11.1 million deaths from coronary heart disease in 2020.

"Atrial fibrillation contributes to congestive heart disease and is responsible for 15 to 20 percent of all strokes," said Fenton, who is the lead investigator at Cornell. "Moreover, its incidence increases with age. As life expectancy grows, so too does the number of people affected by this condition."

Fenton and Gilmour will work toward developing novel computational models of cardiac cells that will allow physicians to understand better the mechanisms responsible for the onset and maintenance of atrial fibrillation and other disturbances of the electrical activity of the heart. They will partner with Stony Brook scientists Drs. Scott Smolka, James Glimm, and Radu Grosu. The research team will combine model checking and abstract interpretation (MCAI), two methods that have been successful in finding errors in computer circuitry and software, and extend MCAI so it can provide insights into models of complex systems, whether they are biological or electronic.

Model Checking is a widely used technique for detecting and diagnosing errors in complex hardware and software designs. It considers every possible state of a hardware or software design and determines if it is consistent with the designer's specifications; it produces diagnostic counter-examples when it uncovers inconsistencies. Model Checking is limited, however, by the size of the systems it can analyze.

Abstract Interpretation, by contrast, doesn't attempt to look at every possible state of a system, but rather aims to develop a simplified approximation of the system that preserves the particular properties that need to be assessed. This makes it possible to analyze very large, complex systems, such as the one million lines of code in the Airbus A380's primary flight control system, but with less precision than is possible with Model Checking.

Combining the Model Checking and Abstract Interpretation algorithms is expected to produce a method of analyzing complex systems that can handle large systems and do so with unprecedented precision. The goal of the Cornell project is to use the hybrid MCAI method to identify the basis for the complex electrical behavior underlying atrial fibrillation, with the expectation that once the mechanism for the arrhythmia is known, appropriate treatment can be developed.

Carnegie Mellon University is the lead institution for this Expeditions in Computing grant, one of three awarded this year. Scientists at New York University, University of Maryland, University of Pittsburgh, NASA's Jet Propulsion Laboratory, and the City University of New York's Lehman College are also participating in the grant and will conduct research in the other areas of the award. The team of researchers includes two Turing Award winners (the Turing Award is Computer Science's Nobel Prize equivalent), a recipient of the National Medal of Science, and awardees of other prestigious research prizes.