Intelligent Systems at Florida Tech

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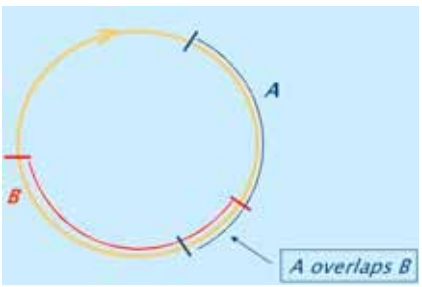
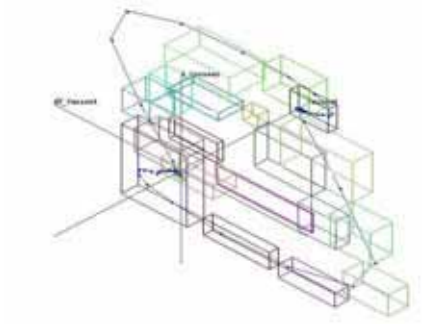
At Florida Institute of Technology, intelligent systems is one of the main areas of research in the Computer Sciences department. The focus in general is on *(i)* how to make computers more intelligent as well as *(ii)* how intelligence can change the ways we compute. Speci cally , one investigates algorithms that can help computers reason (constraint reasoning, spatio-temporal reasoning), learn (machine learning), and see (computer vision). Moreover, we examine how distributed intelligent agents can interact (distributed constraint reasoning and coordination). Our research also includes approaches on looking at how simplistic animal behavior can provide a novel way to solve problems (swarm intelligence).

I. Research

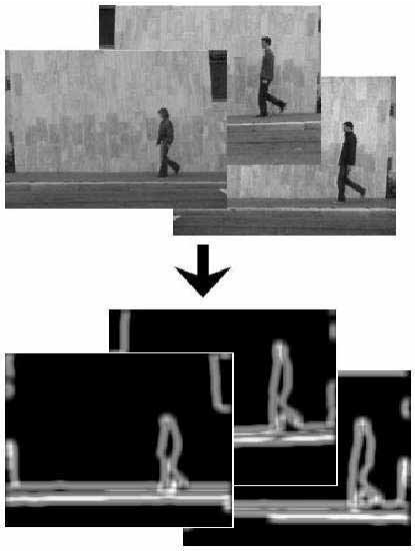
The ability to reason is fundamental to human intelligence for making decisions. The constraint reasoning group focuses on spatio-temporal constraint reasoning. The group has developed new calculi for qualitative spatial reasoning that has applications in geographical information systems. The group has also developed techniques in detecting the culprit constraints in an unsatis able temporal reasoning problem. Recently, we launched a project on understanding creativity from a constraint reasoning viewpoint. The long term vision of this initiative is to develop an intelligent workbench for helping physicists in their creative activities.



Another fundamental aspect of human intelligence is learning—the ability to generate new knowledge and adapt to the changing environment. The machine learning (data mining) group focuses on investigating techniques for anomaly detection and web personalization. Unlike the typical machine learning problem of building a classi er from training examples from two or more classes, the anomaly detection problem necessitates constructing a classi er from training examples from only one class—the "normal" class. The learned classi er is an anomaly detector that identi es and scores anomalies. For intrusion detection, anomaly detection has the potential of detecting novel attacks, which cannot be detected by identifying signatures of existing attacks. For device monitoring with time series data, we extract features, plot them, and generalize them into a sequence of "boxes," which form a model for anomaly detection. For web personalization, we learn a user pro le from a user's bookmarks and use the pro le to re-rank results returned by a search engine so that the top results are closer to the user's interests.

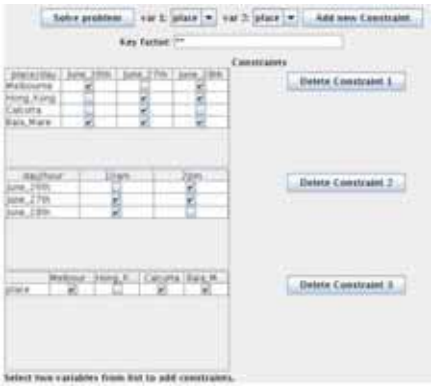


As eyes are windows to the world, the ability to interpret what we see is crucial in providing information for reasoning and learning. The computer vision group concentrates on object recognition, texture analysis, and human motion recognition and understanding. Our texture analysis work has focused on building algorithms for extracting 3D surface shape descriptions from textured surfaces as well as on the analysis and recognition of deforming textures. More recently, research in the group has been concentrated in developing probabilistic models for the recognition of objects and human motion. Object recognition and human motion analysis are key to many important real-world applications such as video surveillance and database content-based retrieval. We also perform research on human-agent interfaces in the area of speech recognition algorithms.

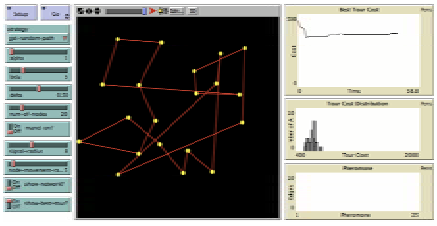


Humans do not live in isolation. Cooperation among individuals allows us to achieve goals that none of us can achieve individually. The ability to coordinate and cooperate is another key aspect of human intelligence. Hence, the agent systems group conducts research in distributed problem solving. The group created and maintains the Secure Multi-party Computation (SMC) language. SMC can be used for building problem solving agents that can run as applications and applets placed on

different machines. The group develops various algorithms for distributed problem solving with privacy requirements, and has a particular focus on distributed constraint reasoning.



Though humans are arguably the most intelligent organism, we have much to learn from others. Hence, the bio-inspired computing group strives to solve real-world problems using techniques based on our understanding of the biological world. Particularly, we study swarm intelligence—how group behavior of simple organisms can produce complex and intelligent behavior. Problem areas that we apply swarm intelligence include wireless sensor networks, distributed data organization, crime activity modeling, social networks, and software engineering.



This research has led to quite a number of publications over the years. Recently, within the past year, the group has published over a dozen articles at peer-reviewed conferences and journals. Also, two research grants were awarded within the past year.

II. Educational and Conference Activities

The intelligent systems group has ve faculty members. Dr. Philip Chan joined Florida Tech in 1995 coming from Columbia University. During 2000-2003, he was joined by Dr. Ronaldo Menezes, Dr. Debasis Mitra, Dr. Marius Silaghi, and Dr. Eraldo Ribeiro. In 2004 the ve faculty members founded the Center for Computation and Intelligence (CCI).

To help students explore various areas in intelligent systems, the group offers courses in arti cial intelligence, bio-inspired computing. computer vision, constraint reasoning, machine learning, and multi-agent systems. Over fteen graduate and undergraduate students actively participate in our research projects. Within the past ten years, at least ten master's and two PhD students have graduated.

In the past few years, we have helped organize and hosted four research conferences held in Melbourne, Florida:

- ACM Symposium in Applied Computing (SAC), March, 2003;
- IEEE International Conference on Data Mining (ICDM), November, 2003;
- ACM Southeast Conference (ACMSE), March, 2006; and
- International FLAIRS Conference (FLAIRS), May, 2006.

Moreover, we have helped organize workshops and conducted tutorials at research conferences, which include:

- Workshop on Integrating Multiple Learned Models, AAAI-96;
- Workshop on Distributed Data Mining, KDD-98;
- Workshop on Data Mining for Computer Security, ICDM-03, CCS-04;
- Workshop on Data Mining Methods for Anomaly Detection, KDD-05;
- Tutorial on Data Mining for Computer Security, KDD-03, SDM-04; and
- Tutorial on Distributed Constraint Reasoning, IJCAI-03, IJCAI-05.

III. Concluding Remarks

The research of CCI members has partially been funded by the Brazilian Funding Agency, Defense Advanced Research Project Agency (DARPA), Department of Homeland Security (DHS), National Aeronautics and Space Administration (NASA), National Science Foundation (NSF), and Of ce of Naval Research (ONR). For more information about the research of the group, please use the following contact address.

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