



Research Areas in Computer Science

Artificial Intelligence and Computer Games:

Our research focuses on AI and computer games from three primary directions. The first looks at the impact of games and creativity on learning through a number of innovative approaches that involve students creating games for teaching, sometimes leveraging and focusing on culture and cultural artifacts, with the goal of improving knowledge retention while providing an enjoyable learning experience. We also explore ways to embed artificial intelligence and data mining techniques into game and learning environments to support learners and improve our understanding of learning and motivation. The second examines the fundamentals of learning, measuring, and understanding human-player experience and interaction in games by analyzing the player performance and interactions to profile, model, and compare. Understanding human behavior in games helps us to explore and develop human-consistent, advanced interactive artificial intelligence that deepens the user immersion and improves interaction. We also explore ways to simplify the AI agent creation process for games to bring new and creative opportunities to the masses. Finally, we focus on heuristic game tree search techniques, especially on simulation-based Monte-Carlo tree search with computer Go as a test bed. Additionally, we investigate the process for generating virtual humans that represent specific cultural groups and their applications.

Faculty: Tiffany Barnes, Ken Chen, Dale-Marie Wilson, Michael Youngblood

Computer Vision and Image Analysis:

The computer vision group addresses problems in image and video analysis including motion estimation, segmentation, recognition, and indexing. The work spans a variety of problem domains and scales from medical image analysis to multimedia search on the Internet. In many projects, machine learning techniques are applied to develop adaptive algorithms. This includes the use of active learning methods which incorporate the end-user in the analysis loop. Example projects include blood cell tracking as a diagnostic tool for physicians, human motion analysis for athletics and surveillance, large-scale multimedia search, skin detection for tracking, and (in collaboration with the network research group) distributed smart camera networks.

Faculty: Jianping Fan, Taghi Mostafavi, Min Shin, Richard Souvenir

Data Management:

The data management faculty conduct research on managing, analyzing, and integrating a wide spectrum of data, ranging from audios, images, videos, to texts. Our current research topics include knowledge discovery and data mining, music information retrieval, multimedia analysis and understanding, multimedia database systems, complex adaptive systems, speech interfaces and virtual agents, and information extraction and integration. Our recent research projects include automatic indexing of audio with timbre information for musical instruments of definite pitch, tag cleansing for exploring large-scale weakly-tagged image collections, human-centered approach to conversational question answering, and personalized semantic integration of Web feeds. Our research is housed in the Knowledge Discovery & Data Mining Laboratory (<http://www.kdd.uncc.edu>) and the Future Computing Lab (<http://www.cs.uncc.edu/fcl/>).

Faculty: Jianping Fan, Zbyszek Ras, Dale-Marie Wilson, Wensheng Wu

Networked Systems:

The networked systems research group addresses issues in supporting emerging network infrastructures, with particular focus on wireless ad hoc networks, sensor networks, delay tolerant networks, smart camera networks, hybrid access networks, and grid computing. Research is centered around the design and analysis of networking protocols and algorithms to support efficient and reliable communication, the development of software engineering methodologies to promote rapid and dependable construction of applications for emerging networked systems, and applying grid computing to computational problems. Projects include the application of microeconomics and game theory for routing protocol design in wireless networks of non-cooperative nodes, development of three-dimensional topology control and routing algorithms for wireless sensor networks, improvement of grid computing user interfaces, provision of adaptive query-based programming abstractions to simplify application development in rapidly changing wireless sensor networks, and the integration of a ubiquitous computing game with social networks to promote sustainable computing communities among undergraduates.

Faculty: Teresa Dahlberg, Jamie Payton, Yu Wang, Barry Wilkinson

Robotics:

The robotics group focuses on multirobot coordination, robotic motion planning and manipulation, sensing-based motion planning in unknown environments, haptic simulation, and dynamic simulation. We develop geometric and optimization algorithms to enable autonomous robots that can move in and manipulate the world around them. Example projects include motion coordination of mobile manipulators, detection and reasoning of contact states between a robotic manipulator and objects, proximity queries, and planning robot motion with dynamics constraints and contact constraints. Our robotics research has also led to digital microfluidic lab-on-a-chip systems for biotechnology applications.

Faculty: Srinivas Akella, Jing Xiao

Visualization:

The Charlotte Visualization Center (<http://www.viscenter.uncc.edu/>) is an interdisciplinary research entity established to pursue both fundamental questions and applications in interactive visualization. The center's research has several major thrusts. First, Visual Analytics aims to understand and gain insights from large, complex data and to translate data into useful knowledge. Current projects include financial visual analytics (bank wire transaction data), geospatial visualization, and knowledge visualization. Second, Large Multi-dimensional Visualization explores highly interactive visualization techniques for multi-dimensional data from fields such as bioinformatics, health analytics, image and video analysis, scientific applications, and networking security. Third, Visualization Graphics explores interactive 3D graphics and virtual reality and develops both new rendering and imaging algorithms and new 3D user interface techniques for visualization applications.

Faculty: Jianping Fan, Robert Kosara, Aidong Lu, William Ribarsky, Kalpathi Subramanian, Zachary Wartell, Jing Yang

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