Robot Algorithms for Modeling Virtual Cityscapes

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Aggregates of numerous entities, from a fleet of vehicles, a group of people, a school of fish, to a swarm of bees, form complex systems that exhibit interesting biological, social, cultural, and spatial patterns observed in nature and in society. Modeling of the collective behaviors remains an open research challenge in robotics, mathematics, biology, physics, computer graphics, architecture, civil and traffic engineering, psychology, and social sciences. These complex systems often exhibit distinct characteristics, such as emergent behaviors, self-organization, and pattern formation, due to multi-scale interactions among individuals and groups of individuals. Despite of decades of observation and studies, collective behaviors are particularly not well understood for groups with *non-uniform spatial distribution* and *heterogeneous behavior characteristics*, such as pedestrian and vehicle traffic in urban scenes, evacuation flows in complex structures, and coupled human-natural systems.

In this talk, I will survey some recent efforts on addressing the problem of modeling, simulating, and directing virtual agents in complex dynamic environments. In particular, I will describe several complementary approaches for local collision avoidance, global path planning, interactive navigation and flow control of multiple virtual entities, including both crowds and traffic, in urban scenes and city highways. I will further highlight the challenges of designing scalable algorithms for these problems by taking advantages of parallelism available on emerging commodity hardware, such as GPUs and many-core processors. I will present potential opportunities of modeling a dynamic cityscape and their application in large-scale motion synthesis, and coordination of multiple autonomous agents in computer games, virtual environments, and digital media. Finally, I will conclude by discussing our experiences and some future research directions.

SHORT BIOGRAPHY: *Ming C. Lin is currently John R. & Louise S. Parker Distinguished Professor of Computer Science at the University of North Carolina (UNC), Chapel Hill. She obtained her B.S., M.S., and Ph.D. in Electrical Engineering and Computer Science from the University of California, Berkeley. She is a Fellow of ACM and IEEE. She received several honors and awards, including the NSF Young Faculty Career Award in 1995, Honda Research Initiation Award in 1997, UNC/IBM Junior Faculty Development Award in 1999, UNC Hettleman Award for Scholarly Achievements in 2003, Beverly W. Long Distinguished Professorship 2007-2010, Carolina Women's Center Faculty Scholar in 2008, UNC WOWS Scholar 2009-2011, IEEE VGTC Virtual Reality Technical Achievement Award in 2010, and nine best paper awards at international conferences. Her research interests include physically-based modeling, virtual environments, sound rendering, haptics, robotics, and geometric computing. She has (co-)authored more than 240 refereed publications in these areas and co-edited/authored four books. She has served on numerous program committees of leading conferences and co-chaired dozens of international conferences and workshops. She is currently the Editor-in-Chief of IEEE Transactions on Visualization and Computer Graphics, a member of 6 editorial boards, and a guest editor for over a dozen of scientific journals and technical magazines. She also has served on several steering committees and advisory boards of international conferences, as well as government and industrial technical advisory committees.*