FAME: Flocking Animation and Modelling Environment

Introduction

It has been foreseen by many game developers and researchers that improved game artificial intelligence (AI) shall be one of the future trends that possess great potentials in enhancing users' gaming experiences. Among the various AI technologies, modeling the natural and social phenomena of group behaviors is one part that is deemed as essential to instill vibrancy, realism and believability in the 3D virtual world of the game.

While many open source or commercial off the shelves (COTS) software can be readily obtained over the web, most provides only means to achieve rather simple steering behaviors. Although these steering mechanisms provides reasonably useful underlying building block to achieve natural and realistic motions, these libraries however, do not give high level control over the formation of groups. Taking this cue, we have developed Flocking Animations and Modeling Environments or FAME in short, an AI library that is equipped with a comprehensive set of tools to enable easy creations of group behavioral animations that are equipped with flexible controls over the formation shape and movements of groups or flocks, which is extremely useful and valuable for rapid digital games development and simulation.

Objectives

In this project, we aspire to make new and significant advancements in the field of constrained flock modelling which has remained a challenging topic of interest, especially in the context of real time rendering. In particular, we seek for flock modelling algorithms that accomplish specified path following and obstacle avoidance missions automatically while satisfying the shape, space and time constraints imposed as requirements by developers or the general users. Various forms of constraints have been investigated while fulfilling the given tasks. The project concentrates particularly on the following core features:

Formations: refers to group movement techniques that mimic military formations. In formation control, each unit is guided toward a specific goal location and heading, based on its position in the formation and the current situation (Pottinger 1999, Dawson 2002). Often the formations must split or distort themselves to facilitate movement through tight areas and rejoin subsequently.

Command Hierarchy: used when dealing with artificial intelligence (AI) decisions at different levels. For example, in military combat, the general directs the high-level strategy on the battlefield, while the foot soldier concentrates on individual combat. The levels in-between deal with cooperation between various platoons and squads. The benefit of a command hierarchy is that with decision making segregated across layers, better encapsulations, compatible and abstractions are facilitated. This liberates the conceptualization of command hierarchies to be units of information (knowledge, belief, emotion, etc.) encoded in computational representations suitable for group communication.

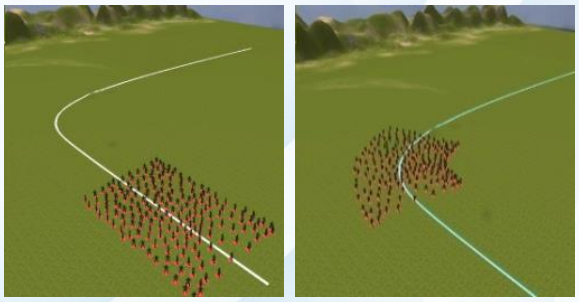
Memetic Representation of Behaviors: In the book titled The Selfish Gene by Richard Dawkins, memes is defined as the "basic unit of cultural transmission or imitation". The term has inspired the new science of

memetics which today represents the mind-universe analog to genetics in cultural evolution. Using the memes inspired concept, we examine how traditional flock agents can evolve by learning the low level behaviors among each neighboring members and be composited to form high level complex group behaviors to create a more natural and realistic effect. To address the ever increasing complexity and dynamic nature of flocking and group behavior, the Memetic Representation of Behaviors is conceptualized in memetic computation, that autonomously acquires increasing level of capability and intelligence through memes embedded or learned from interactions.

Project Highlights & Technical Details

Shape Rigging and Path Constraint

The shape constraint mechanism enables the flock to bend along the curvature of the path more naturally and realistically while still satisfying the imposed formation constraints.



Environmental Constraint

The environmental constraints refers to the naturally occurring phenomenon such as the forces of wind, the current of water as well as the conditions of the terrain that might affect the way the flock moves in the simulation environment.

Obstacle Avoidance Mechanism

Real-time obstacle avoidance mechanisms prevent flocking agents from colliding into obstacles in the scene by steering them away from objects such as the trees, fences, or houses.

Shape Morphing Mechanism

A shape morphing algorithm allows a flock to transform from a shape constraint to another naturally. Other constraints may involve requiring all agents to start /stop at the same time, fulfilling the minimum travelled distance etc.

Applications

MAGIC is in collaboration with Richmanclub Studios on a flagship film project “The Boy And His Robot”. FAME is being used to create massive battle scenes with thousands of soldiers and robots. The technology has also been packaged as Crowd Simulation API and published in Unity Asset Store for more game developers to efficiently create crowd effect in their games.

Publications

C. S. Ho, Y. S. Ong, X. Chen, A. H. Tan, FAME, Soft flock formation control for collective behavior studies and rapid games development," in International Conference on Simulated Evolution And Learning, (2012).

C. S. Ho, Q. H. Nguyen, Y. S. Ong, and X. Chen, Autonomous multi-agents in flexible flock formation," in Motion in games, (2010).