PhD topic
Scenario and interaction-ready agents

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Context & motivation

Enabling either humans, social robots or autonomous vehicles to interact with a group of virtual 3D agents is challenging, but would bring high benefits in many situations: It could be used in gaming and serious gaining (humans training in simulated environments), as well as for training social robots or vehicles in challenging, yet controlled scenarios. In all these cases, the virtual crowds should both be able to follow some coarse user-designed scenario, and to react in real time to the actions of the user.

In this thesis, we will focus on humans using VR to interact with virtual agents. The latter should both be reactive to the user's actions and obey the pre-defined scenario assigned to them. Our methodology will be to rely on artificial intelligence, and especially reinforcement learning to progressively improve the behaviour of the virtual agents.

Objectives

- Develop solutions for expressive design of populated scenes guided by scenarios,
- Design mechanisms for agents to switch between behaviours guided by scenarios or guided through interactions with users and/or autonomous systems (virtual training of artificial intelligence),
- Introduce "interaction level-of-details" to balance simulation performances with interaction complexity,
- Evaluate the effect of interacting agents on the plausibility of the virtual scene (improved immersion and presence for users / transferability for AIs trained in synthetic worlds).

Expected Results

- A set of virtual environments populated with numerous characters with interaction capabilities,
- Methods to allow the expressive design of scenarios that shape the population and its activities,
- Populated virtual environments to train artificial intelligences (e.g., motion interaction training).

Planned visits to CLIPE Partners

- [4 months] Trinity College Dublin (Carol O'Sullivan). Perceptual evaluation studies.
- [4 months] Silversky3D (Marios Avraamides). VR industry applications.
- [2 months] University College London (Anthony Steed).

Candidate's expected kills

Master in Computer Science with speciality in computer graphics or in AI/machine learning.
C++ programming. Good level in English.

Bibliography

[1} Steering Behaviors for Autonomous Cameras. Quentin Galvane, Marc Christie, Rémi Ronfard, Chen-Kim Lim, Marie-Paule Cani. MIG 2013 - ACM SIGGRAPH conference on Motion in Games, Nov 2013, Dublin, Ireland. pp.93-102,

[2} Simulation of Past Life: Controlling Agent Behaviors from the Interactions between Ethnic Groups. Chen-Kim Lim, Marie-Paule Cani, Quentin Galvane, Julien Pettré, Talib Abdullah Zawawi Digital Heritage International Congress 2013, Oct 2013, Marseille, France

[3] Crowd Sculpting: A space-time sculpting method for populating virtual environments Kevin Jordao, Julien Pettré, Marc Christie, Marie-Paule Cani. Computer Graphics Forum, Wiley, 2014, EUROGRAPHICS 2014, 33 (2), pp.351-360.

[4] Crowd Art: Density and Flow Based Crowd Motion Design. Kevin Jordao, Panayiotis Charalambous, Marc Christie, Julien Pettré, Marie-Paule Cani 8th ACM SIGGRAPH Conference on Motion in Games, MIG '15, Nov 2015, Paris, France. pp.167-176.

[5] WarpDriver: context-aware probabilistic motion prediction for crowd simulation. D Wolinski, MC Lin, J Pettré. ACM Transactions on Graphics (TOG) 35 (6), 1-11.

[6] Group Modeling: A Unified Velocity-Based Approach. Z Ren, P Charalambous, J Bruneau, Q Peng, J Pettré. Computer Graphics Forum 36 (8), 45-56.

[7] Crowds by example. Lerner, A., Chrysanthou, Y., & Lischinski, D. (2007, September). In Computer graphics forum (Vol. 26, No. 3, pp. 655-664). Oxford, UK: Blackwell Publishing Ltd.

[8] The pag crowd: A graph based approach for efficient data-driven crowd simulation P Charalambous, Y Chrysanthou. Computer Graphics Forum 33 (8), 95-108

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