Master Internship in Computer Graphics and Animation

Animated coherent groups of virtual animals in 3D natural environment

Place : LIX, Campus de l'Ecole Polytechnique, Palaiseau

Employer : Ecole Polytechnique (*Taking place at LIX – Laboratoire d'Informatique de l'Ecole Polytechnique)*

Internship start: April - September 2024

Supervisors: Damien Rohmer (damien.rohmer@polytechnique.edu)

Context of the Internship:

The design of motion for virtual creatures is a key task for many applications. They can be used to enhance the realism of 3D films or to create plausible reactive characters for video-games. In a more scientific basis, controlled characters can be used for computing visual simulations from priors. We will consider the particularly challenging application of generating realistic animation for virtual fauna exhibiting typical daily pattern routine (eating, resting), with prey and predatory behavior (e.g. wolf / dear hunt).
A typical application of such virtual model lie on representing viable prehistoric sceneries featuring antic species such as step lions, or mammoth that were living in our regions a few hundred of thousands of years ago. While only sparse data about prehistoric animal population, displacement and behavior are known from Archaeologist's studies, these could be used as prior knowledge to adapt and transfer available data from current animal morphology and locomotion to prehistoric one.

Objective:

Our objective is to define a multi-scale approach to control the locomotion of group of animals, with a specific emphasis of models applicable to prehistoric ones in natural environments.
At a large scale (1), one should be able to control group behavior, as well as the interaction between different groups and the type of animals. This can rely on our previous work on global flora and fauna relation [Ecormier-Nocca 2021], while extending it toward additional user-control. At the individual level (2), the locomotion of the animal should both be valid with respect to their morphology, as well as automatically adapt to the type of terrain (walking or running on a flat ground, in a meadow, in water, versus climbing a steep slope). This part may follow our recent work developed in [Alvarado22]. At the group level (3), we may extend our previous work on animating adaptable crowd patches [Jordao14] to the case of an open, natural environment, while extending the adaptation using reinforcement learning approaches [Kwiatkowski23]. This part will contain the core focus of this research.
Our research methodology will explore the integration of crowd patch motion across different hierarchical levels: large-scale for diverse animal groups, medium-scale for individual species, and small-scale for specific animal trajectories. This will be achieved using a learning-based model that accounts for species-specific high-level behaviors. Initially, we will apply this integrated approach to a single species at one scale, with the ambition to later expand and generalize it to encompass larger scales and diverse species.

References

[**Ecormier-Nocca21**] P. Ecormier-Nocca, G. Cordonnier, P. Carrez, A.-M. Moigne, P. Memari, M.-P. Cani. Authoring Consistent Landscapes with Flora and Fauna. ACM SIGGRAPH, TOG, 2021.

[**Alvarado22**] E. Alvarado, C. Paliard, D. Rohmer, M.-P. Cani. Real-Time Locomotion on Soft Grounds with Dynamic Footprints. Frontiers in VR, 2022.

[**Jordao14**] K. Jordao, J. Pettré, M. Christie, M.-P. Cani. Crowd Sculpting: A space-time sculpting method for populating virtual environments**.** Eurographics, CGF, 2014.

[**Kwiatkowski23**] A. Kwiatkowski, V. Kalogeiton, J. Pettré, M.-P. Cani. MIG 2023.

Requirements:

- Master level student, or last year of Engineering School, with good Computer Science and Applied Math background.
- Followed class or performed projects in Computer Graphics and/or 3D geometry.
    - Specific knowledge in Computer Animation is a plus
    - Specific knowledge in Reinforcement Learning and Video Game AI is a plus.
- Good practical skills in programming typically in Python and/or C++. Being able to autonomously quickly develop code and experiment with computer animation context.
- Interest for Game environment is appreciated.
- Research experience and interest in pursuing this topic in PhD is appreciated.