

## **Muscle based control for avatar animation : a synergy based approach**

*Charles Pontonnier<sup>1,2,3</sup>, Ana Lucia Cruz Ruiz<sup>1,2</sup>, Antoine Muller<sup>1,2</sup>, Georges Dumont<sup>1,2</sup>*

1. IRISA/INRIA MimeTIC, Rennes, France
2. ENS Rennes, Bruz, France
3. Ecoles de Saint-Cyr Coëtquidan, Guer, France

Muscle-based control is transforming the field of physics-based animation through the integration of knowledge from neuroscience, biomechanics, and robotics, which motivate the creation of smarter characters, and most importantly, enhance motion realism. Since any physics-based animation system can be extended to a muscle actuated system, the possibilities of growth are tremendous. However, modeling muscles and their control remains a difficult challenge. This talk aims at presenting the main control approaches used in the animation field for muscle-actuated avatars, with a particular focus on a method currently developed in our research team. This control method is based on muscle synergy extraction and adaptation to drive a direct dynamics simulation. The experimental protocol for synergy extraction and model are first presented, followed by a control method consisting of a series of optimizations to adapt muscle parameters and synergies to match experimental data. An application to a direct dynamics control of a human arm throwing motion is presented. Results show that the motion can be accurately reproduced thanks to the muscle synergy extraction and adaptation to the model, even if challenges remain numerous.