Choreographic Style Transfer

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Context: This PHD thesis is proposed as part of the Living Archive of Isadora Duncan, a collaboration between Conservatoire National de la Danse, Mocap Lab Paris, the IMAGINE team at Inria Grenoble and the Ex-Situ team at Inria Saclay, under the artistic direction of Elisabeth Schwartz. The thesis will take place in the IMAGINE team at INRIA in Montbonnot. It is offered to students holding a Masters degree in Computer Graphics.

Objectives:

The living archive of Isadora Duncan aims to constitute an archive of Isadora Duncan choreographies, by recording performances by several dancers who learned them from Isadora Duncan's students. Isadora Duncan herself refused to be filmed because she felt the frame rate of cinematography (24 fps) could not do justice to her choreographic style. Using a combination of high-speed video and motion capture (120 fps), we are creating a unique archive that effectively captures the style of Isadora Duncan's choreography and can serve as a foundation for future research and teaching.

In previous work, the IMAGINE team has designed new representations of human movements based on the concepts of line-of-action curves and space-time curves [1,2] which appear to be better suited to the natural choreographic style of Isadora Duncan than the traditional stick figures used in other work [3,4]. In a recent Master's thesis, we enriched this representation with a mechanical model of the dancer's movements, in the shape of deformable ribbons originating from the dancer's chest and ending in the dancer's head, feet and hands. The Master's thesis has worked out the mathematical details of the ribbon dynamics and proposed methods for computing the ribbon motions from a set of markers placed on the dancer's body.

In the proposed Phd thesis, we want to extend this preliminary work for transferring the choreographic style of Isadora Duncan to other physical simulations, such as fluids (water, smoke), clothes and sculptures. This will require fundamental research work for (i) understanding the free-style dance style of Isadora Duncan from recorded motion capture; (ii) generating physically-based simulations synchronized with the recorded dances; and (iii) transferring the choreographic style of the recorded dances to the generated simulations. To resolve these issues, we will use a combination of Laban movement analysis [5,6], physical modeling [7,8] and deep learning methods [9,10,11,12].

The Phd will also demonstrate the results in a real-time immersive VR application allowing to interact with the simulations and control their execution in real-time (play, pause, rewind and slow motion) The VR application will be used to perform experimental validation of the PHD work in close collaboration with our partners at Conservatoire National de la Danse, Ex-Situ team at Inria Saclay and Mocap Lab in Paris.

References:

1. Martin Guay, Marie-Paule Cani, Rémi Ronfard. « The Line of Action: an Intuitive Interface for Expressive Character Posing", ACM Transactions on Graphics, Proceedings of ACM SIGGRAPH Asia 2013.
2. Martin Guay, Rémi Ronfard, Michael Gleicher, Marie-Paule Cani. « Space-time sketching of character animation", ACM Transactions on Graphics, Proceedings of ACM SIGGRAPH 2015.
3. Lars Wilke, Tom Calvert, Rhonda Ryman, Ilene Fox. "Animating the Dance Archives", VAST 2003.
4. Tom Calvert, Lars Wilke, Rhonda Ryman, and Ilene Fox. "Applications of Computers to Dance", IEEE Computer Graphics and Applications, vol. 25, no. 2, March 2005.
5. E. Schwartz, « Les trames architecturales du mouvement chez Rudolf Laban », *Nouvelles de danse*, 2000.
6. Rudolf Laban, *Espace dynamique*, traduction française par E. Schwartz Contredanse. 2003.
7. Fdili Alaoui, S., Bevilacqua, F., Bermudez, B., and Jacquemin, C. Dance Interaction with physical model visualization based on movement qualities. International Journal of Arts and Technology, IJART 2012
8. Martin Guay, Rémi Ronfard, Michael Gleicher, Marie-Paule Cani. Adding dynamics to sketch-based character animations. Sketch-Based Interfaces and Modeling (SBIM) 2015.
9. L. Crnkovic-Friis et L. Crnkovic-Friis, « Generative Choreography using Deep Learning », International Conference on Computational Creativity, Paris, 2016.
10. Daniel Holden, Ikhsanul Habibie, Ikuo Kusajima, Taku Komura. Fast Neural Style Transfer for Motion Data. IEEE Computer Graphics and Applications 37(4): 42-49 (2017).
11. A. Aristidou, E. Stavrakis, M. Papaefthimiou, G. Papagiannakis, et Y. Chrysanthou, «Style-based motion analysis for dance composition », *The Visual Computer*, vol. 34, p. 1725-1737, 2017.
12. M. Pettee, C. Shimmin, D. Duhaime, et I. Vidrin, « Beyond Imitation: Generative and Variational Choreography via Machine Learning », *arXiv:1907.05297,* July 2019.