

Internship proposition

Academic Year: 2022 - 2023

Acronym: ECOMOCAP

Project title: Towards reliable and versatile marker-less motion capture through real and synthetic data collection.

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Collaborations: This project is part of a collaboration with the Laboratory on Design, Manufacturing and Control (LCFC) of the Campus of Metz of ENSAM.

Project description: (1 page maximum)

Motion analysis can be a determining factor in the management of certain pathologies affecting the locomotor system or for the prevention of musculoskeletal disorders in the context of occupational health. For reasons of complexity and cost, reference systems, based on reflective markers and infrared cameras such as the VICON system, are rarely used in clinics or in industry and remain tools for R&D (in biomechanics, ergonomics, cobotics, etc.) and for entertainment (movies, video games). In this context, a marker-less system without constraint for the subject, could have a major impact on the use of motion analysis in application fields.

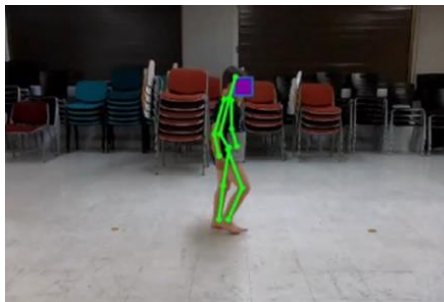


Figure 1. *Left.* Marker-less gait capture in Bicêtre Hospital (Le Kremlin-Bicêtre). *Right.* Marker-less handling motion capture in lab environment.

Through two PhD theses, one of which is still in progress, and in collaboration with the LCFC (ENSAM – Metz), our research on the subject has led us to introduce a Artificial-Intelligence-based system equipped with 4 cameras, also called ECOMOCAP (1–3) . This system is promising when used in real situation for gait analysis (see Figure 1 Left) or in laboratory environment for the handling motion (see Figure 1 Right).

However, in order to analyze a wider range of motion in a wider range of environments, the underlying artificial intelligence requires new quality data for its learning. A synchronized collection of the marker-less system and a marker-based system is then essential and will be the topic of this internship. For this purpose, we will investigate two approaches:

1. More real-world data with a new joint collection of marker-based and marker-less motion capture for a selected number of movements. (Figure 2 Top)
2. Synthetic data using existing in-house datasets, creating avatars for each subjects and virtual environments. (Figure 2 Bottom)

The added value of each approach will be quantified by the progresses of the artificial intelligence on the accuracy of kinematic outputs. Computer programming skills, particularly in Python, are required for applying to this internship. Interest in deep learning and computer graphics is a plus.

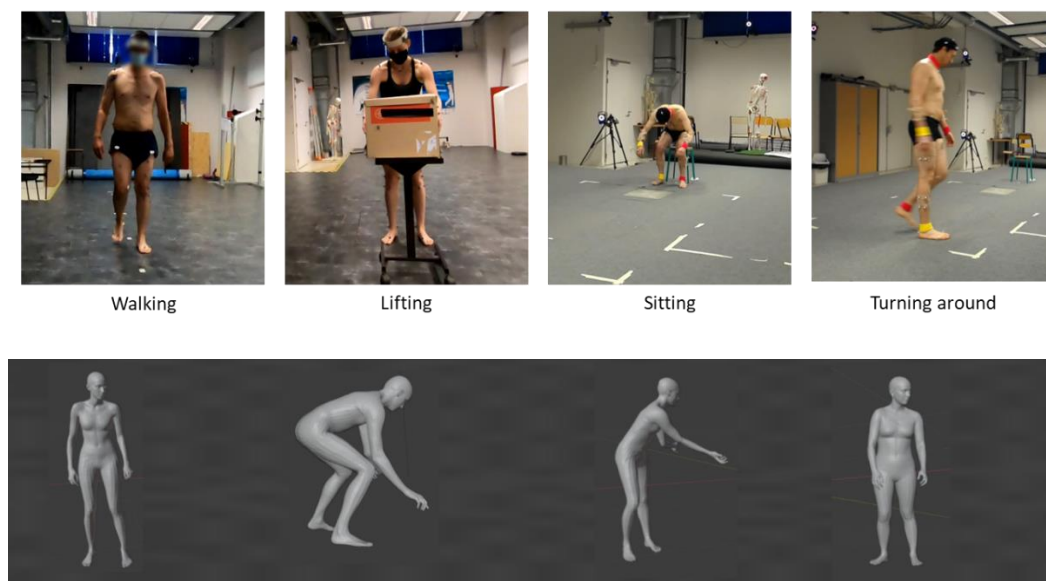


Figure 2. *Top.* In-lab data collection of selected movement. *Bottom.* 3D animated avatars to immerse in virtual environments.

References

1. Vafadar S, Skalli W, Bonnet-Lebrun A, Khalifé M, Renaudin M, Hamza A, et al. A novel dataset and deep learning-based approach for marker-less motion capture during gait. *Gait Posture*. 1 mai 2021;86:70-6.
2. Vafadar S, Skalli W, Bonnet-Lebrun A, Assi A, Gajny L. Assessment of a novel deep learning-based marker-less motion capture system for gait study. *Gait Posture*. 1 mai 2022;94:138-43.
3. Jiang J, Skalli W, Siadat A, Gajny L. Kinematic parameters estimation during gait based on a multi-view markerless motion capture system. *Gait Posture*. 1 sept 2022;97:S17-8.