

Postural risk assessment and motion capture to improve the ergonomics of a workstation

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1 Introduction

The World Health Organization (WHO) indicates that Musculoskeletal Disorders (MSD) “range from those that arise suddenly and are short-lived, such as fractures, sprains, and strains, to lifelong conditions associated with ongoing pain and disability” [1]. These conditions can manifest in individuals of any age and across global populations. They carry significant economic implications, leading to a decline in work efficiency and adversely impacting the well-being of those affected.

The "[Regional Occupational Health Plan 2022-2025](#)" for the Occitanie region mentions several figures to illustrate the necessity of placing health and prevention at the heart of work in the region: MSD represent 80% of recognized occupational diseases; 71% of employees are exposed to postural and articular constraints; 32% of employees are exposed to one or more chemicals regardless of their sector of activity. As for the statistical service responsible for labor, employment, and vocational training within the public statistical system (DARES), its analysis No. 031 from August 2022 lists the thresholds above which exposure can be qualified as "onerous" (according to the Medical Surveillance of Employees' Exposure to Occupational Risks (SUMER) survey from 2017). However, it specifies that most quantification methods are based on medical investigators' expertise and employees' perceptions [2].

We focus on identifying and automatically calculating ergonomic risks in this context and this preliminary work. First, we conduct a literature review on a well-known method called "REBA". Then, we use motion capture to analyze the human motion and calculate the REBA score automatically.

2 REBA method and Motion Capture

The REBA was published in 2000 by [Hignett and McAtamney](#) as a preliminary stage in developing a postural analysis tool. The objective of REBA is to assess the ergonomic risk for the postures related to musculoskeletal. It classifies the ergonomic risk into five levels, from negligible to very high. Initially, the REBA method was conceived for the nurse in the hospital. Thanks to its advantage and the advanced technology, the application of the REBA method was spread to many fields regarding health, such as manufacturing, agriculture, etc. Over 70 percent of REBA applications were published in the scientific literature between 2014 and 2020, coupling this method with a MOCAP technology [4].

Our research uses Movella's Xsens motion capture solution, which offers a wireless and non-intrusive solution. It enables users to perform natural movements without cumbersome equipment by using wearable sensors (see Figure 1). This technology accurately models human body movements and provides several measurements that are essential for evaluating

ergonomics assessment during work, ensuring high precision and eliminating dependency on human error [5]. We propose calculating the REBA score with Movella’s Xsens motion capture solution in this work. The primary aim of obtaining accurate ergonomic assessment scores is to integrate them into decision-making models to optimize human factors in industrial processes.

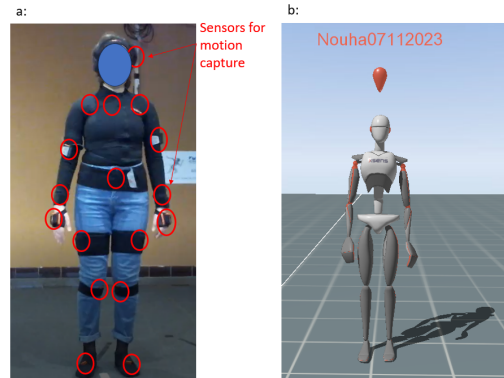


FIG. 1: a: Experimental setting with inertial sensor-based Movella’s Xsens full body suit.
b: Body kinetics and kinematics digital model in Movella’s Xsens solution.

3 Conclusions and perspectives

The REBA method and motion capture offer an integrated approach that enables human factors to be effectively considered in decision-making. This combination is particularly relevant in areas such as flexible work allocation and assembly lines, as highlighted in the paper of Slama et al. [6]. This preliminary work on the state of the art in industrial optimization, using motion capture in conjunction with REBA scoring, contributes to advancing knowledge in the field of ergonomics and operational efficiency. This innovative approach offers promising prospects for improving working conditions, optimizing industrial processes, and reinforcing health and safety within professional environments.

References

- [1] Musculoskeletal health, . URL <https://www.who.int/news-room/fact-sheets/detail/musculoskeletal-conditions>.
- [2] Isabelle Niedhammer, Kylian Coindre, Sarah Memmi, Sandrine Bertrais, and Jean-François Chastang. Working conditions and depression in the French national working population: results from the SUMER study. *Journal of psychiatric research*, 123:178–186, 2020.
- [3] Sue Hignett and Lynn McAtamney. Rapid Entire Body Assessment (REBA). *Applied Ergonomics*, 31(2):201–205, 2000.
- [4] Manuel Hita-Gutierrez, Marta Gomez-Galan, Manuel Diaz-Perez, and Angel-Jesus Callejon-Ferre. An Overview of REBA Method Applications in the World. *International Journal of Environmental Research and Public Health*, 17(8), 2020.
- [5] Workplace Ergonomics | Movella.com, . URL <https://www.movella.com/applications/health-sports/workplace-ergonomics>.
- [6] Rim Slama, Ilhem Slama, Houda Tlahig, Pierre Slangen, and Oussama Ben-Ammar. An overview on human-centred technologies, measurements and optimisation in assembly systems. *International Journal of Production Research*, 0(0):1–23, 2023.