# Measuring physiological parameters through head-micromovements by the VR/AR headset for user bio-feedback and adaptive experience

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**Application Domain:** Astronaut Training and Operations Support

**Technical Team:** Hands, face and body tracking

Micro-electromechanical systems (MEMs) technology embedded in the VR/AR headsets represents a complementary solution to assess the mechanical heart's function and respiratory activity by measuring head micromovements, exploiting the ballistographic (BCG) principle. Accordingly, we developed an innovative approach to obtain sensor-free biofeedback through a web-based VR application of guided breathing using an Oculus Quest.

By measuring as head-BCG the user's respiratory activity during the experience, a final score was computed to show the user's performance in following the guided breathing. The accuracy of this approach was studied in 34 subjects (26 for training the underlying algorithm, 8 for testing), resulting in very good results (97% accuracy in breathing period estimation) when compared with gold standard techniques.

An extension of such methodology to obtain beat-to-beat heart-rate variability is currently under development.

The developed methodology could have a big impact on the development of any VR/AR application in which it could be of interest to evaluate the user's physiological status, like during training, rehabilitation, pain management, and anxiety treatments, without using additional sensors while preserving an immediate user experience (functional for the deployment in complex settings such as the hospital) and thus allowing ubiquitous tracking of the user, without the need to be confined in a laboratory setting.

As VR/AR could have also applications for astronauts in space for training purposes, as well as for mental and therapeutic support to isolation and confinement in long-duration missions, this solution could be utilized to achieve immediate evaluation of astronaut's performance in terms of physiological parameters without the need to further instrument the astronaut with other sensors, thus representing opportunistic measurements in a context in which experimental time is very expensive.