

Can Smart Phone-Based Sensors Provide Reliable And Repeatable Lameness Data

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This project will test the reliability and repeatability of body-mounted and smart phone IMU sensors with machine learning and computational algorithms in lame and non-lame horses.



Musculoskeletal injuries remain one of the most important issues in the equine industry, especially considering sport-related activities. There is a delicate balance between a desirable improvement in performance and overstress of specific tissues, leading, over time, to a possible clinical injury. In addition, the recent increase in interest from the general population for an improvement in horse welfare and the social license to operate during equestrian training sessions and competitions reinforces the importance of a better understanding of equine biomechanics. Inertial measurement units (IMUs) are portable wearable sensors (accelerometers, gyroscopes, and magnetometers) attached to different body segments.

In humans, IMU systems have been validated in several sport-related activities, providing real-time spatiotemporal and biomechanical loading information. Several studies using different IMU systems in horses demonstrate promising use of this technology in collecting varying stride parameters (i.e., stride length, stance time, retraction/protraction angles) in orthopedic clinical cases and healthy horses performing diverse activities. In comparison to humans, these tested horse-IMU systems report only limb motion characteristics and have not been used to assess biomechanical loading information. A novel IMU system combined with machine learning techniques and computational algorithms has been able to collect timing, distance, and biomechanical loading in numerous human subjects during various athletic activities, showing excellent correlation to the gold standard optical motion capture systems and force platforms.

Recently, this novel technology utilized sensors embedded in smart phones to collect kinematic parameters in humans and showed a good correlation between the body-mounted

and smart phone-embedded sensors. Additionally, the technology using smart phone embedded sensors was demonstrated to be reliable and accurate in detecting biomechanical parameters during functional tests. There are no previous studies on the reliability and repeatability of this new technology or comparison between body-mounted and smart phone-embedded sensors in horses.

We hypothesize that this novel technology will provide reliable and repeatable output parameters from both smart-phone embedded and body-mounted sensor systems, and the obtained data will be similar between both systems in lame and non lame horses exercising in a standardized protocol. To test our hypothesis, we propose to collect data simultaneously from body-mounted and smart phone-embedded sensor systems with the novel IMU technology in horses exercising on a high-speed treadmill three times per week for a total of three weeks before lameness induction and then starting 2 weeks after lameness induction, once a week for a total of 8 weeks.

Importance to the Equine Industry: This non-invasive and practical technology will allow equine professionals to detect changes in limb and holistic movement in real-time during both training and competition. This technology is the “next generation” of gait analysis in the equine athlete and, importantly, is what the field is missing in giving veterinarians clues regarding impending injury and important information into the biomechanical state of tissues at risk to injury.

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