COMPARATIVE EXERCISE PHYSIOLOGY

ISSN 1755-2540 – 2022 – VOLUME 18 – SUPPLEMENT 1

Wageningen Academic Publishers

Determining average weight-bearing asymmetries in relation to clinical lameness scores in horses

M.A. Weishaupt, J. Müller-Quirin, M.T. Dittmann, S. Arpagaus, C. Roepstorff and T. Wiestner
Vetsuisse Faculty University of Zurich, Equine Department, Winterthurerstr. 260, 8057 Zurich, Switzerland; mweishaupt@vetclinics.uzh.ch

Despite widespread use of objective gait analysis for lameness assessment, it remains difficult to distinguish between slight natural asymmetric motion patterns and clinically relevant, pain-related compensatory movement or weight-bearing asymmetries. This study aimed to investigate the normal variation of weight-bearing asymmetries in clinically sound horses before and after inducing lamenesses of various degrees, in order to generate sensitive reference ranges based on which further lameness investigation should be considered. Peak vertical force asymmetries (dFz_{peak}) in fore- and hindlimbs were measured on an instrumented treadmill at trot in 51 riding horses. In 21 horses, slight, mild and moderate lamenesses were induced successively in all 4 limbs (fore- and hindlimb inductions at separate days, maximally 6 inductions per horse and day) using the sole pressure model. Lameness was assessed visually (live) and scored from 0/5 (sound) to 4/5 (severe). Mean values and 95% confidence intervals of dFz_{peak} in percentage of bodyweight (bwt) were calculated for the different lameness scores. Mean dFz_{peak} values of horses in the sound situation were 1.9% bwt between fore- and 1.6% bwt between hindlimbs. Differences between lameness categories were significant (ANOVA with post hoc pairwise comparison); however, there was an overlap of dFz_{peak} between the different clinical lameness grades, especially between grades ≤2/5. Mean dFz_{peak} increased markedly with lameness ≥grade 2/5 (2/5 forelimb 10.4% bwt; hindlimb 6.6% bwt). The variability of load distribution between contralateral limbs at trot within categories exacerbated the setting of a clear threshold for clinically relevant lameness. However, the data indicate that dFz_{peak} in clinically sound horses rarely exceeds 3-4% bwt (weight-shift of 15-20 kg in a 500 kg horse). We suggest that horses with higher dFz_{peak} values should undergo further examination.

Estimation of hoof-on/off moments using inertial sensors and deep learning

H. Darbandi[1], F.M. Serra Bragança[2], B.J. Van Der Zwaag[1], M. Rhodin[3], E. Hernlund[3], S.J. Hobbs[4], H.M. Clayton[5] and P.J.M. Havinga[1]
[1]University of Twente, Pervasive Systems Group, Drienerlolaan 5, 7522 NB Enschede, the Netherlands, [2]Utrecht University, Department of Equine Sciences, 3584 CM Utrecht, the Netherlands, [3]3Swedish University of Agricultural Sciences, Ulls väg 26, 75007 Uppsala, Sweden, [4]University of Central Lancashire, Centre for Applied Sport and Exercise Sciences, Preston, Lancashire PR1 2HE, United Kingdom, [5]Michigan State University, Large Animal Clinical Sciences, 3145 Sandhill Road, Mason, MI 48854, USA; h.darbandi@utwente.nl

Temporal stride parameters are essential measures in equine biomechanics. A prerequisite for calculating them is identifying hoof ground contact (hoof-on) and lift-off from the ground (hoof-off). These moments can be determined using signals from an inertial measurement unit (IMU) mounted on the hoof. However, a hoof IMU is vulnerable to damage. This study investigated the possibility of accurately estimating hoof-on/off moments from IMUs mounted on limbs (as safer body locations) using deep learning (DL). The dataset consisted of 41,000 strides measured with Equimoves IMUs (200 Hz) mounted on 3rd metacarpal/tarsal bones and right hooves of 21 dressage horses ridden on sand-fibre during walk, trot, canter, piaffe and passage. Hoof-on/off moments were labelled using specific peaks from Euclidean norm of hoof IMU acceleration signals. Then, we tried to estimate the labelled hoof-on/off moments by assigning limbs IMUs signals as input to train models based on long short-term memory networks. Independent of gait type, the front limb model yielded the accuracy and precision (mean ± standard deviation of time differences between labelled and estimated hoof-on/off moments, in milliseconds) of 0.6±9.0 and 0.0±6.0 for hoof-on and -off timing, while the hindlimb model delivered -6.5±16.0 and 5.6±13.0, respectively. Both models outperformed the results of previous studies. In conclusion, we can attach IMU to less vulnerable locations and achieve accurate and precise estimation hoof-on/off moments using DL.