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Supplementary Item 2:

IMU Acceleration magnitude peak (AMP) algorithm

The vector magnitude of the acceleration signal presents clear peaks close to the hoof-off and hoof-on moments. Visually, these match the same force plate events closely and consistently. This makes the acceleration magnitude an interesting feature for use in stride segmentation. We developed an Acceleration Magnitude Peak (AMP) algorithm that uses this feature for detecting hoof-off and hoof-on moments. An important aspect of the AMP algorithm is that it has very low computational overhead, thus being feasible for embedded implementation in a dedicated IMU device.

The AMP algorithm cannot be used directly without extra information from a different source due to noise present in the acceleration signals caused by movement of the limb during locomotion. To find the correct peaks, a crude indication of where the desired event was located in time was needed. Therefore, we employed another algorithm to first get an estimate of where the hoof-on or hoof-off events were located and subsequently, we employed AMP to obtain more accurate estimates of the actual times these stride events occurred. Each of the other algorithms was therefore evaluated with and without AMP. The AMP algorithm was a more computationally demanding algorithm and therefore, it was not possible to running in a real-time configuration.

Algorithm 1

This algorithm for hoof-on and hoof-off detection is based on the analysis of fused signals from gyroscope and accelerometer sensors using proprietary filters of the IMU. The algorithm consists of four stages executed in sequence: (1) detection of angle extremes; (2) filtering of detected angle extremes and determining mid-swing and mid-stance points; (3) hoof-off detection; and (4) hoof-on detection.

Algorithm 2

This algorithm closely follows one algorithm previously described in the literature [1]. The orientation of each IMU is calculated and used to transform the accelerometer data from the sensor's reference frame to a global reference frame. In a second step, the movement of the horse is aligned with the x-axis by transforming the orientation of the data on a stride-by-stride basis. This way, at least the strides of the experiment in which the horse is in view of the cameras and steps on the force plate are aligned with the x-axis.

Algorithm 3 and 4

Algorithms 3 and 4 are based on a multi-level processing routine where an initial processing is performed with algorithms 1 and 2 and a second post-processing routine using the AMP method results in algorithms 3 and 4 respectively.