

## Horse Lameness Estimator Using Inertial Sensors

Vinícius Betim Guimarães, discente de graduação, Universidade Federal do Pampa,  
Campus Alegrete  
Alessandro Gonçalves Girardi, docente, Universidade Federal do Pampa

viniciusguimaraes@unipampa.edu.br

One of the serious problems faced by veterinarians in reference to horses is lameness, being the most frequent dysfunction in horses, essentially when it comes to racing animals. Furthermore, it is also the most economically important medical condition affecting horses. Lameness in horses is when the animal, in this case, the horse, demonstrates some disturbance of the locomotor system, which can be displayed in various ways when the animal has an injury, for example, on the paw, and it starts to limp. The objective of the project is to develop a lameness system in horses, based on 3 inertial sensors, that is, the accelerometer and gyroscope will be the main device for capturing the equine's movements. In addition, the project proposal is to develop a low-cost system, thus allowing veterinary offices, breeders, athletes, students, and universities that work with horses daily, to have access to a tool like this; otherwise, the idea is also to develop a system that is easy to use and implement by the end user. The system proposed by the project consists of using three inertial sensors to capture data on the horse's movement. Constituting itself as follows: one on the animal's head, another on one of the front paws, and finally, one on top of the pelvis. These inertial sensors will communicate with a computer via WiFi, where a program will be found to capture the data during the desired period and thus process it. After saving the data, they will be analyzed by a code that will work with this information of the acceleration as a function of time and will perform the integration of this data, to find the displacement as a function of time. The method to calculate the displacement through the inertial sensor is by performing the integration in the frequency domain. The inertial device used has the following characteristics: 6 DOF, accelerometer, and 3-axis gyroscope. It is powered by a battery and has Wifi for a maximum range of 150 meters and can capture data with up to 3000 Hz acquisition rate. The procedure to capture the data consists, of placing the devices in the respective points of the horse, making it perform 50 meters trots, 4 times, on a terrain preferably flat and smooth, so that the horse can perform a "clean" and as natural movement as possible. Identifying possible claudication in the horse is done by calculating the range of motion of the head and pelvis. When the animal has an injured leg, for example, one of the front legs, the range of movement of the animal's head and pelvis is different, that is, because one of the legs is injured, the horse tends to support its weight. in the "good" paw, causing a movement of the divergent amplitude of the head in relation to each paw. An analogous idea is applied to the hind legs; however, the pelvis is used as a reference. The results found by the project were: to find the representation of the displacement as a function of time for the accelerometers of the head and pelvis, identify when the horse has any sign of lameness, mainly in which paw, to be able to apply a simple and easy-to-implement capture system that

made it possible to test several animals, have an application that allows the user to view graphic information and messages with elucidations about it of the movement performed by the horse and easy to use. Therefore, as mentioned earlier, the area of detection of lameness in horses is a very rich field to be explored, in addition to, above all, dealing with an existing problem that afflicts many sectors that work directly with these animals. It is also concluded that the project has achieved its main proposed objective, which is to identify the "lameness" and essentially, identify which is the injured paw and do all this in a simple and very intuitive way for the end user, regarding the execution and system implementation. However, it is understood that the project is still in its early stages and there are many points to be improved and many tests in horses for the validation of the identification.

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**Index Terms:** lameness, sensor, horses.