Title: Gait data collection and processing (Summer Scholarship project) ET 4/2018

Principal Researcher(s):	**Bob Colborne**
Date Funded:	**October 2018**
Status:	**Completed**
Amount Funded:	**$5,000**

Introduction

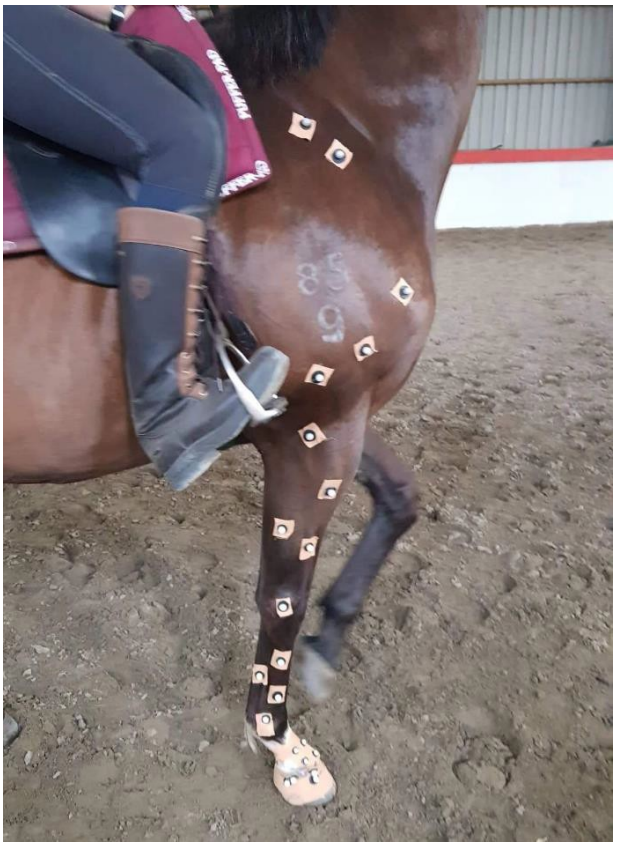
This summer scholarship was undertaken under the supervision of Dr Bob Colborne in conjunction with PhD student Alienor Bardin and is a part of Alienor's PhD project. The project aims to analyze the effects on equine gait of ground surface perturbations using the Qualisys infrared camera system and accompanying computer based modelling techniques, including Visual3D and Anybody, to better understand the stresses on elements of the distal equine limb during the stance phase of locomotion. In the most recent data collection phase, both soft and hard surface perturbations were created to determine the immediate compensatory effects on gait.

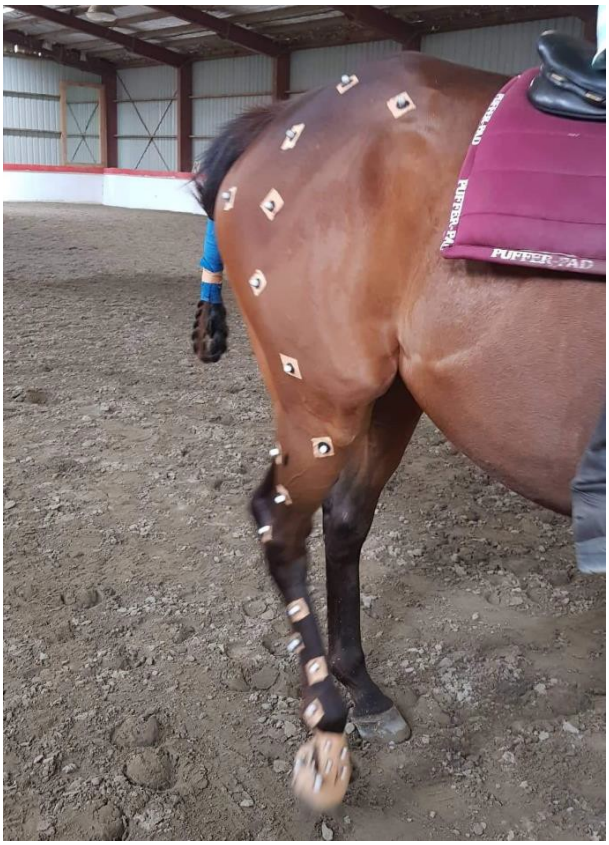
My role in the project included both helping with the data collection phase and performing the first stages of data processing using the Qualisys and Visual 3D programs. This has been a 10 week process.

Data Collection

The data collection phase of this summer project was undertaken at Tielcey Park Equestrian Centre, using their covered arena facility. Before data collection could commence the arena had to be prepared. This involved the construction of a 1.3m x 1.3m perturbation pit which had to be dug out of the sand and rock surface of the arena. This was alternately filled with timber, foam and varying amounts of sand to achieve a hard and soft perturbation area in addition to the normal baseline sand surface. The recording area was then measured to ensure that two whole stance phases could be captured within the data measurement area. The six cameras were then carefully placed, lined up with the measurement area and focused to ensure that we could capture movement of the horses from several viewpoints. While the cameras were taken down between each session of data collection, recording of the set up from this initial phase allowed for consistent collection.

Data collection occurred over two weeks and involved five horses. These horses were pure Thoroughbreds of varying age and size. They were not selected based on any criteria other than their breed. They were supplied and ridden by three separate riders. Prior to being ridden the horses had to be fitted with markers on their right lateral fore and hind limbs. These markers were constructed from spherical balls covered in strips of infrared reflective tape. These were attached to the horse using medical tape and super glue. The markers were positioned to carefully demarcate the centre of rotation of the joints as well as the segments (see photo). The tail was tied to ensure that it did not interfere with the markers when the horse moved.



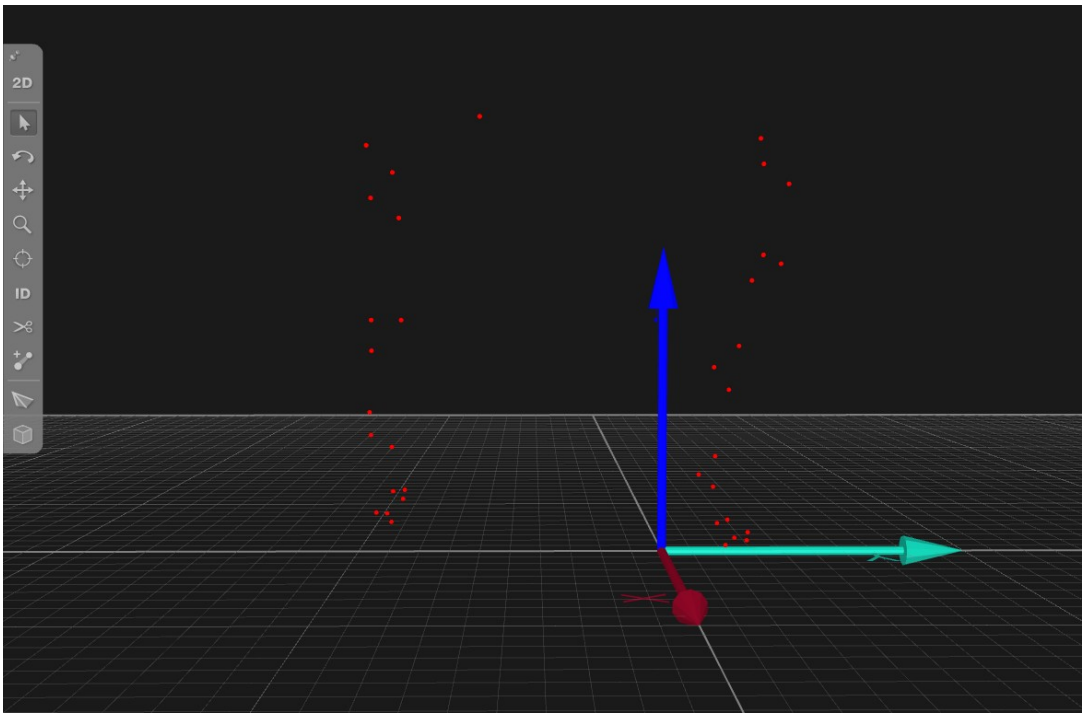


The horse was then ridden through the measurement space, first with the hard perturbation, then baseline, then soft. For each perturbation the horse was trotted and then cantered through the space sufficient times to achieve four trials per gait per limb. This usually involved around ten trials per gait per perturbation. Each recorded trial was four seconds long.

The main challenge encountered with the data collection phase was the falling of markers during the horse's movement. To ensure the markers could be removed, a minimal amount of superglue needed to be used. However, this meant that markers, especially those on the hoof, frequently fell off during trials. These were quickly replaced, and their positions were replicated as closely as possible using the glue residue from the original placement.

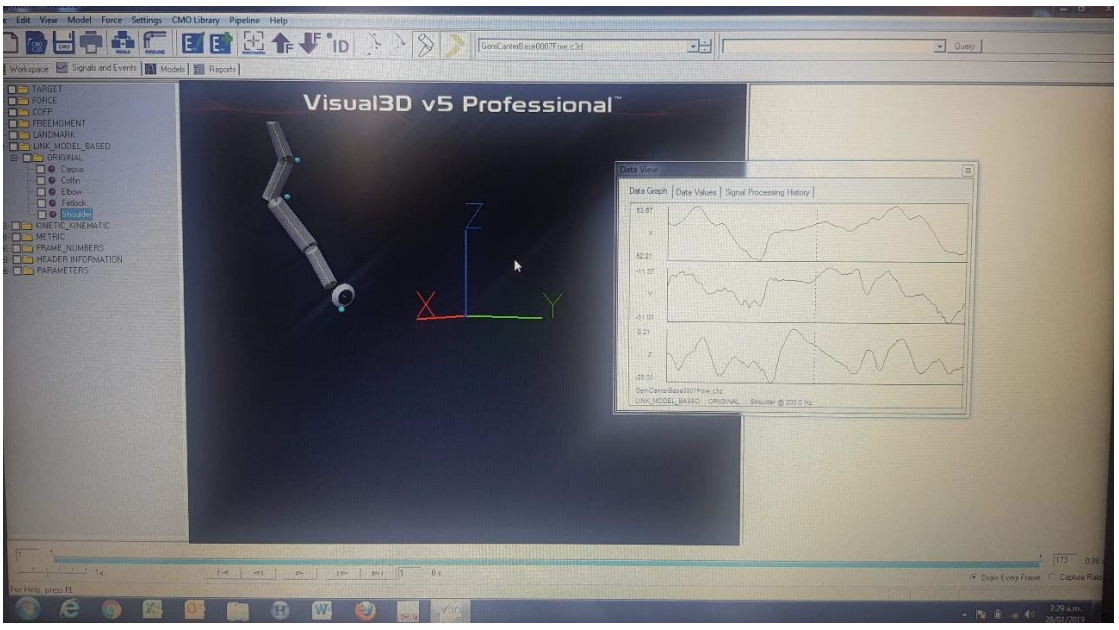
Data Processing

Once data for the five horses had been collected it needed to be analyzed and processed using the program Qualisys. Each trial was cut down such that the time line parameters encompassed only the frames between four prior to the beginning of stance phase one and four after the end of stance phase two. The data was then processed by assigning marker names to the markers on the limbs and ensuring that they remained correctly tracked throughout the timeline. This process can be particularly difficult, especially with the hoof markers, as they tend to get lost sporadically to the cameras and cross-confused. Each trial was then exported as a .c3d file to be further processed using Visual 3D and Anybody.



Each horse took around three days to process using Qualisys, with the result being, on average, three good trials exported as .c3d files per gait, per perturbation, per horse.

Following processing in Qualisys, the data were inputted into the program Visual3D. Using the individual calibration for that horse, the motion files for all gaits and perturbations could be assigned to a calibration model. The application of each motion file to the model allows the computing of model data. For each trial the joint angle at each frame was calculated for each of five joints: shoulder, elbow, carpus, fetlock and coffin. These angles were plotted into a master Xcel file for each horse, with a sheet assigned to each joint. This allowed comparison of the change in joint angle over stance and swing phases between trials. We were particularly interested in the change over time within one type of perturbation and across different perturbations.



The output from both the Qualisys processing and Visual 3D will be used in a model developed by Alienor Bardin, using the program Anybody. This will allow for more sophisticated analysis of the stress and strain of specific non-bony elements, in particular tendons and ligaments in the distal limbs.

Data from the right hindlimb will also be processed in much the same way using Qualisys and then Visual 3D

Conclusion

This summer scholarship project has been a great learning opportunity for me. I feel that I have gained in confidence, not only around horses but also in data processing and handling methods. At the same time, I feel that I was able to contribute positively to this project through my inputs. I am very grateful for the experience that it has given me.