

Novel approaches to measure the quality of gaits in the Franches-Montagnes (FM) horse population

Quality of gaits is an important indicator trait in horse breeding to estimate future performance. An international research project aims to precisely measure the quality of the gaits in the only remaining indigenous Swiss breed in order to identify underlying genetic trends.

Traditionally, animals with remarkable expression of breed type, conformation or gait quality are preferentially used for breeding. The evaluation and description of these traits are made by the judges of the breed. While there is a discernible progress in the quality of gaits in the FM population, no causal genetic mechanism could yet be identified. This could be due to the fact that the evaluation of gait quality is for now only based on human perception (subjective grading by judges of the breed) and is not measured. An international research project based in Switzerland between the Swiss national stud farm of Agroscope (SNSF), the Swiss Franches-Montagnes breeding federation (SFV) and the Universities of Bern, Zurich, and Utrecht (NL), aims to make quality of gaits measurable in horses.

Why measure what is already described?

The FM breeding federation and the Swiss national stud farm, in collaboration with the Bern University of Applied Sciences, School of Agricultural, Forest and Food Sciences, Zollikofen have been using the linear description data from field test evaluations to estimate breeding values for each assessed trait. The genetic effect on a given trait (heritability, see Table 1) will depend on the number of genes influencing the phenotype, as well as our ability to describe it, i.e. the quality of the field test data. In contrast to the height at withers, which shows a high heritability (>0.4) and is determined by only few genes, it is likely that quality of the gaits will be determined by many genes each having a small effect. Which is why this current project aims to describe the quality of the gaits in as many details as possible and to measure these with technical instruments to improve data quality.



Plate 1: Traditional evaluation of gait quality requires judges of the breed to assess the horse walking and trotting in hand

How does one define quality of the gaits?

In the first step of this project, a group of experts tried to break down the commonly used traits such as amplitude or impulsion into measurable parameters. Regularity for example would be a combination of the coordination of each limb within a stride phase and the variability between several consecutive strides.

Table 1: Heritabilities (2015) of gait parameters evaluated by judges of the breed in comparison to the measured parameter height at withers

Parameter	Heritability	Effect of the heritability*
Walk: step length	0.17	Medium
Trot: step length	0.31	Medium
Trot: impulsion	0.29	Medium
Trot: elasticity	0.28	Medium
Correctness of gaits	0.02	Low
Height at the withers	0.79	High

* A heritability of 0.01 to 0.15 is considered low, 0.16 to 0.40 as medium and over 0.40 as high. The higher the heritability, the easier it is to influence a parameter by selection.

Twenty stallions from the SNSF, as well as four pure-bred Franches-Montagnes horses belonging to a separate breeding population and lent by their independent federation, were chosen for the practical trial. The group was prepared for this large locomotion study for six weeks at the SNSF.

Locomotion study in the Equine Performance Lab of the University of Zurich

The Equine Performance Lab owns an instrumental treadmill for horses which can measure the ground reaction forces between the ground and the horse's limbs, and a high-speed motion capture system (MOCAP) for kinematic analysis (plate 2). The latter can trace reflective markers placed on anatomical landmarks and reconstructs their three-dimensional flight path.



Plate 2: A fully equipped FM stallion trots on the instrumental treadmill. The elastic bands attached to the hoof allow to position the hooves on the treadmill to calculate ground reaction forces.

Copyright: Ernst A. Kehrlı / Vetcom UZH

For this study, the horses were additionally equipped with IMU sensors (Inertial Measurement Units, plate 3). These sensors are constituted of a magnetometer, a gyroscope and an accelerometer. Similarly to the MOCAP system, the sensors can trace the movement of the body segments to which they are attached. In that way, joint angles or the amplitude of the step can be measured. The advantage of these miniature sensors is their use outside of a laboratory. They could, once validated, be used in field tests for breeding evaluations.

The stallions were measured at the walk and trot, at four different speeds each and the whole procedure was filmed from the front, the side and the back.



Plate 3: Reflective markers were positioned over some of the IMU sensors to assess the agreement between the MOCAP and IMU systems.

Copyright: Ernst A. Kehrlı / Vetcom UZH

What's next?

The complexity of the data requires a careful and stepwise analysis. While one part of the research consortium concentrates on the extraction of the measurements, the SNSF will analyse the videos from the lab test, have them evaluated by the judges of the breed in the traditional manner, and compare them with the results from the over ground triangle presentation. The traditional evaluations will then be related to the highly standardised measurements from the lab to allow us to interpret the measurements based on the evaluations. The obtained results will then be used with the genetic sequences of the stallions to identify gene regions closely associated with gait quality.

This current research project attracts large interest from the international community. This innovative project puts the Franches-Montagnes horse and its breeders in the centre of equine research in Europe. We are looking forward to a long lasting collaboration between researchers, judges and breeders.

Annik Gmel
Agroscope, Swiss National Stud Farm