3-D video morphometric measurements of conformation of the Icelandic horse

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Background - the project

- Quantify the conformation of the Icelandic horse in an objective way
  - By the use of a three dimensional video morphometric method dveloped by Nathalie Crevier-Denoix and Philippe Pourcelot at the Veterinary University at Alfort in Paris
- The aim is to relate the 3-D morphometric measurements to scores for conformation and riding ability

Objective of this presentation

- To give a short description of the method and its application in the Icelandic horse
- To present the first results concerning the accuray of the method by assessing the repeatability of trackings within the same reference images and between trackings of the left and right side of the same horse

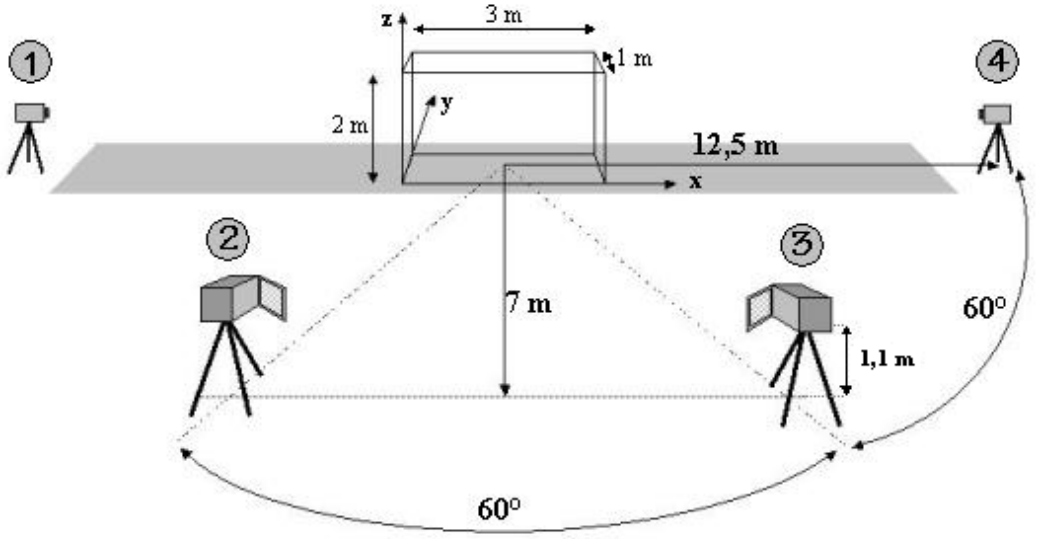
Material

- 72 horses were filmed at breeding field tests in Iceland in the years 2008-2010
  - 20 stallions and 52 mares of ages 4 to 10 years (most of them 4-6 years old)
- All were judged on an ordered categorical scale for conformation and riding ability

Filming of the horses

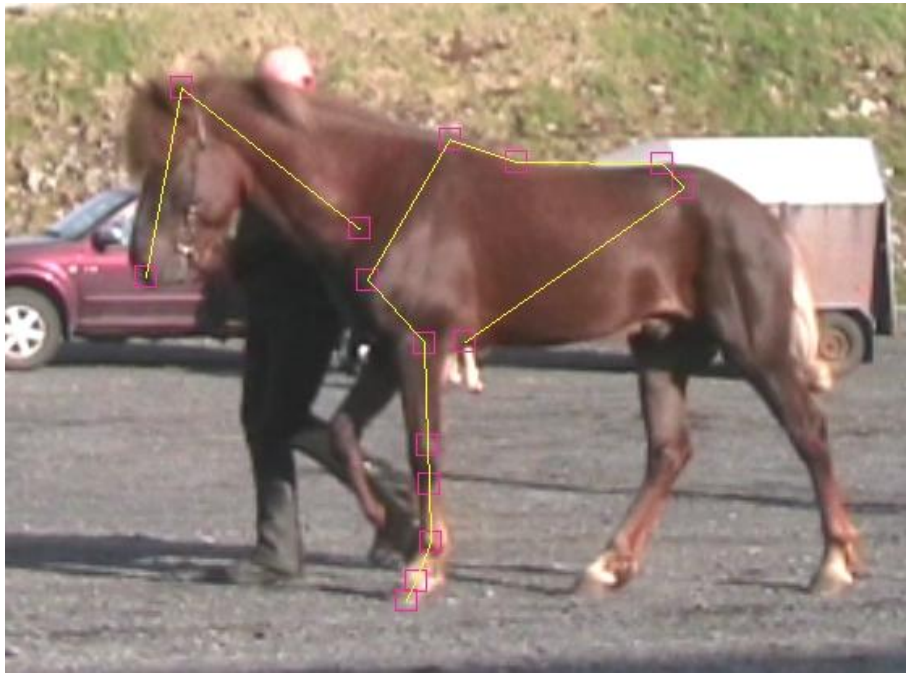
- The horses are recorded in walk, using four video cameras, without the use of skin markers

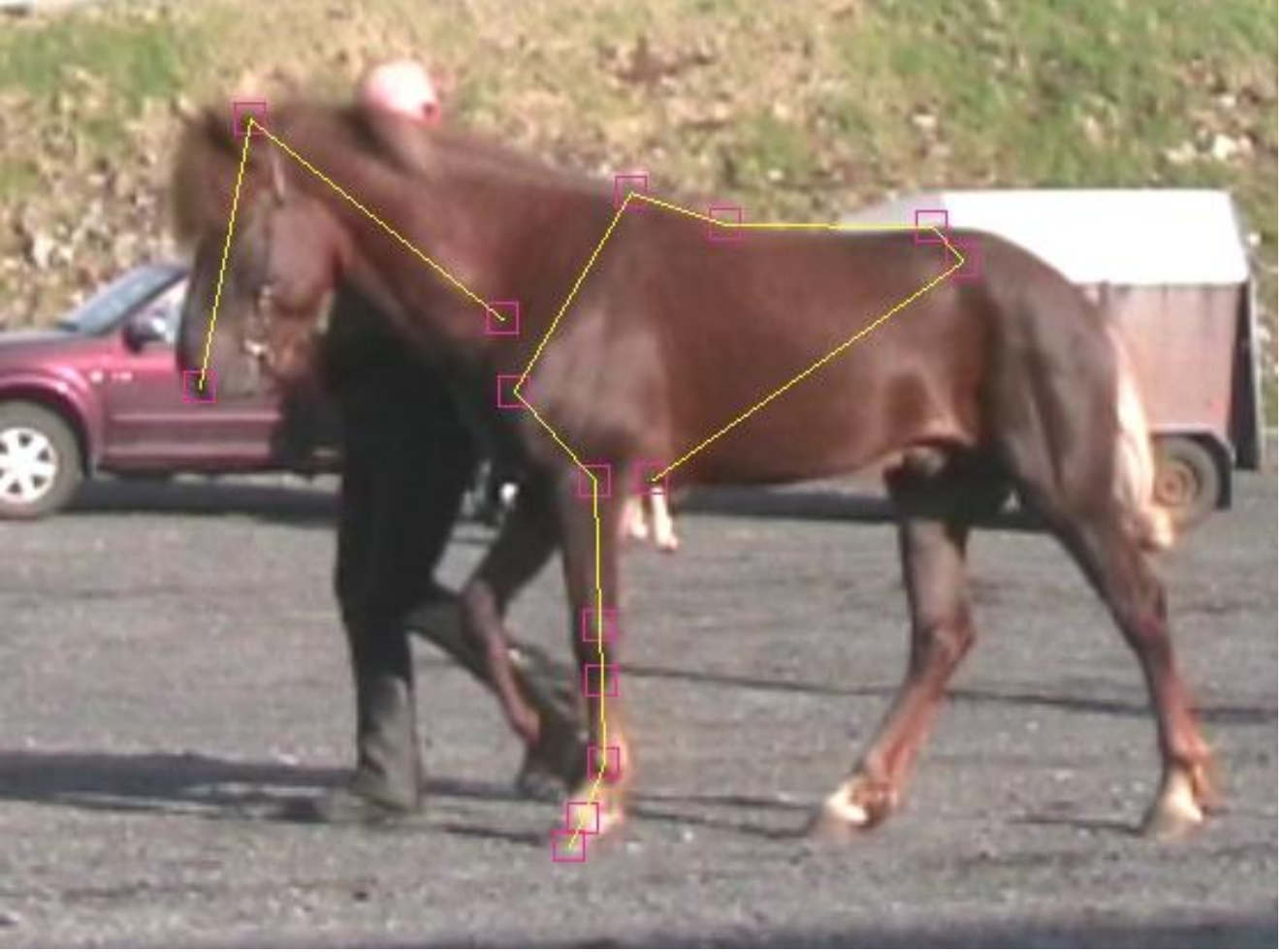
- An aluminum structure with known size is filmed before each session
- To be able to calibrate the four films – define the space in 3-D

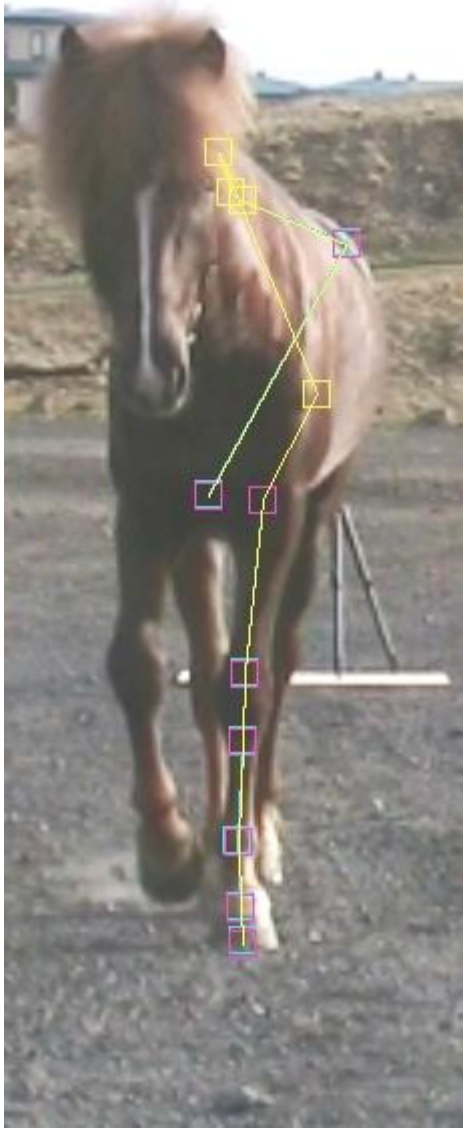


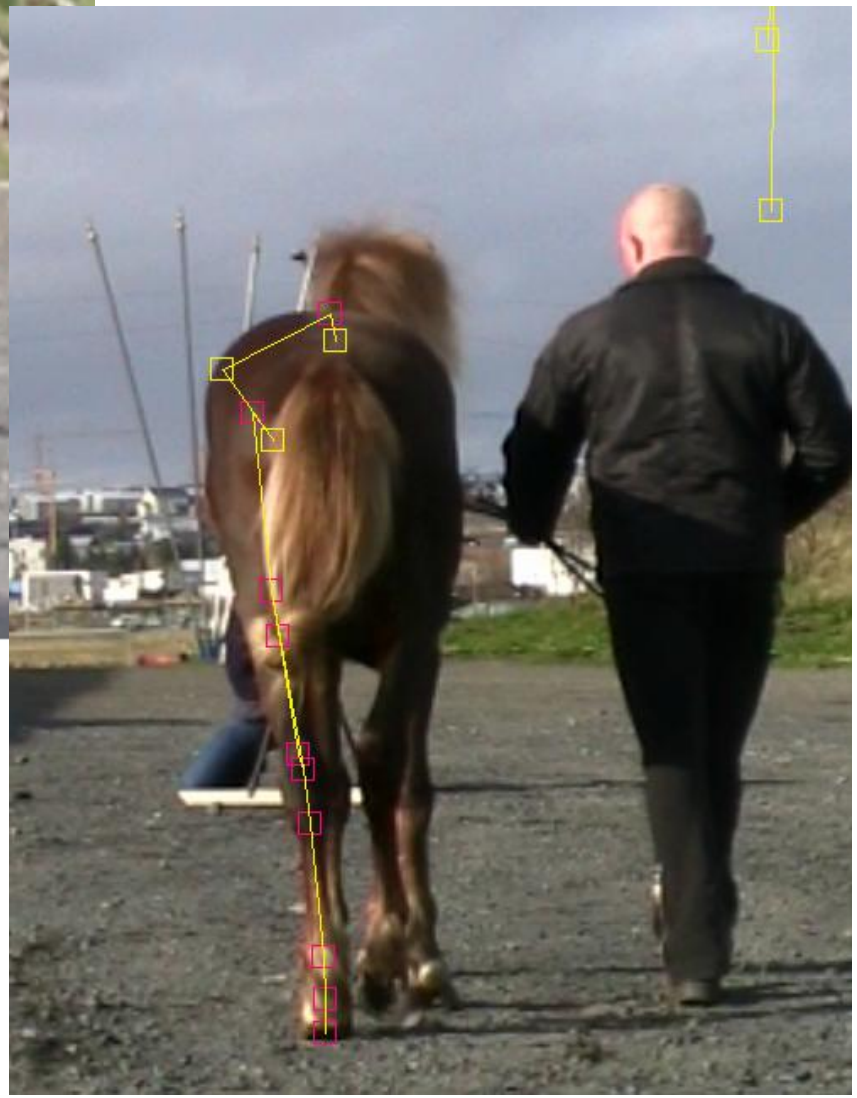
Processing of films

- Data processing is performed off-line
- The four films of one filming session are synchronized
- Two sets of reference images (RI) are selected and saved for each horse





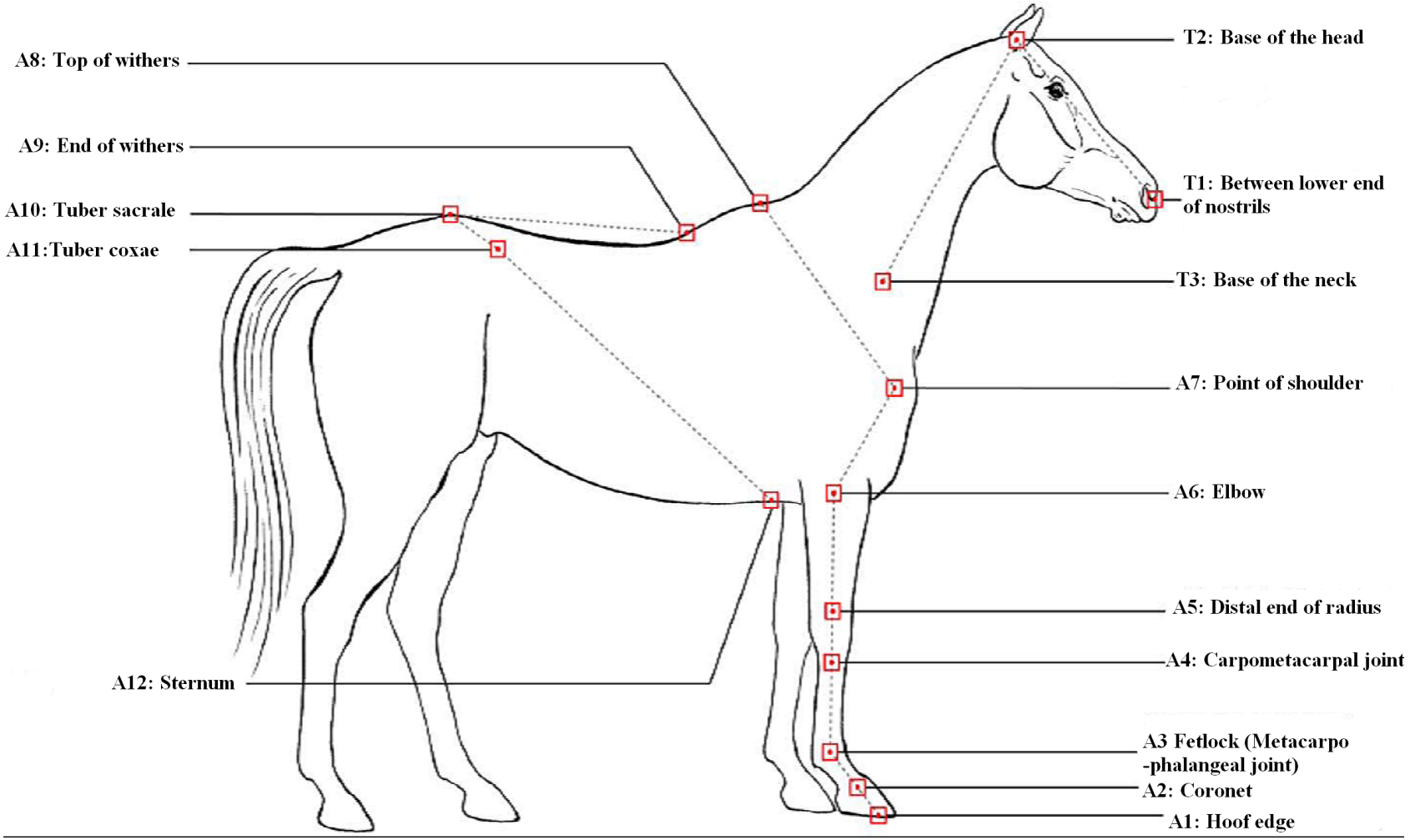




Placement of anatomical landmarks

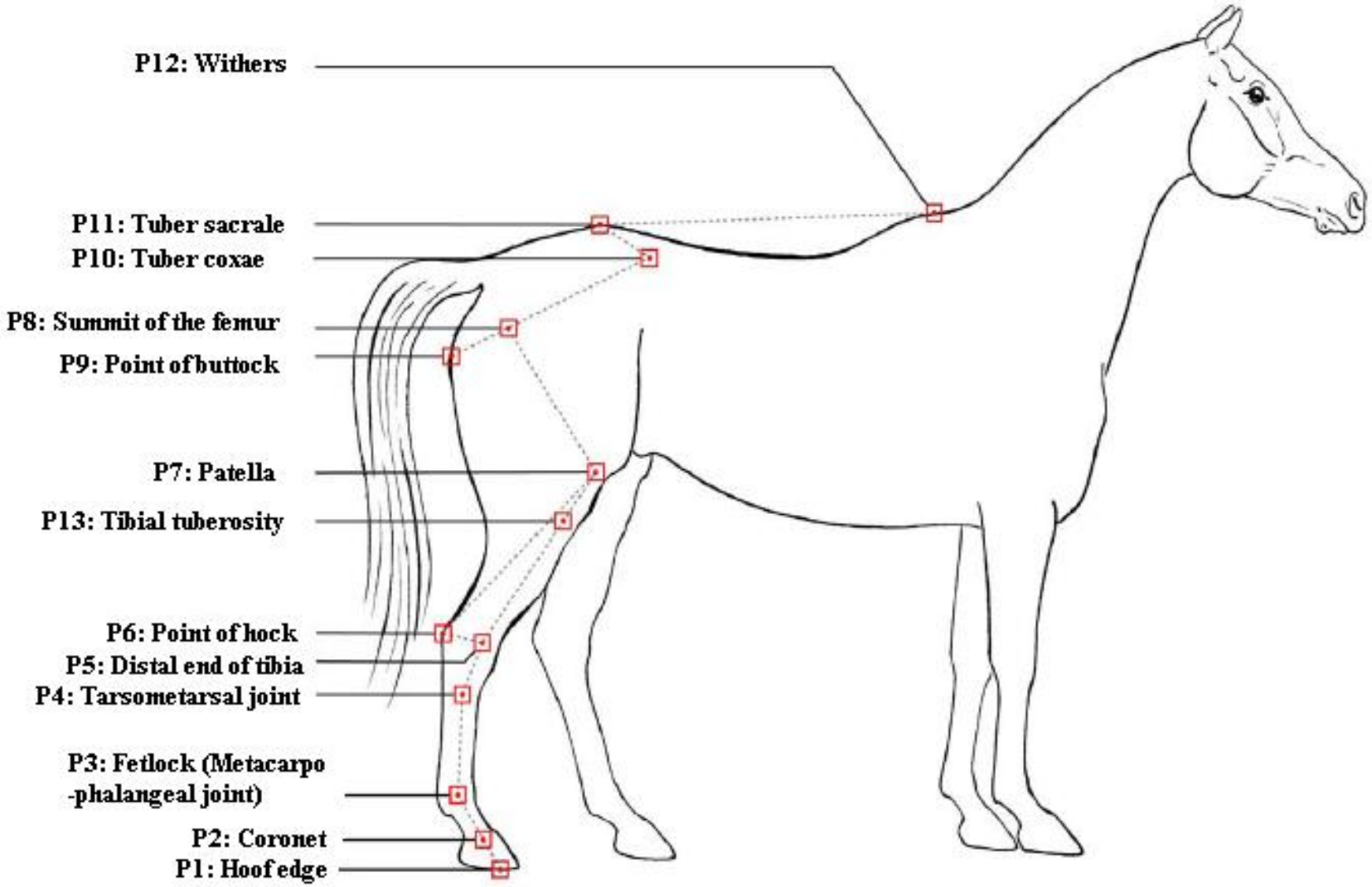
- Manual placement of anatomical landmarks
  - Framesaver, Calibrateur, Conformer
- When the same landmark has been placed on two views its 3-D coordinates are calculated
  - Using Direct Linear Transformation (POURCELOT et al., 2000)
- The morphometric parameters are automatically calculated from these coordinates
- They consist of heights, segments lengths, joint angles, inclinations and proportions
- 119 morphometric parameters were calculated

Anatomical landmarks



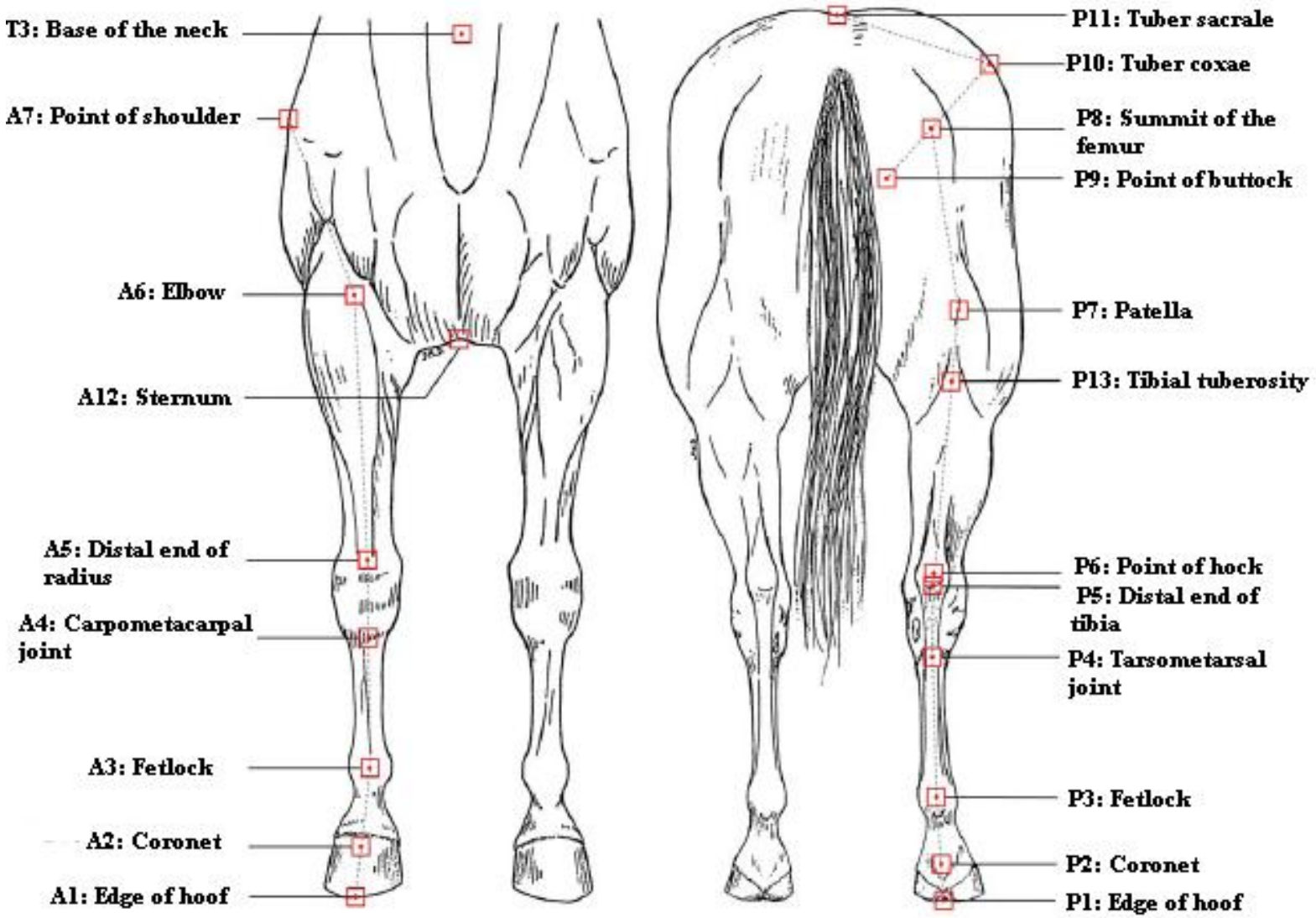
- T1 – T3 and A6 – A12 were tracked

Anatomical landmarks



- P6 – P12 were tracked

Anatomical landmarks



Results

- All parameters were normally distributed
- The Pearson´s correlation between height at the withers and height and segment length parameters was in the range of 0.02 to 0.88 (in general higher than 0.30)
  - Low correlation between height at withers and length of the croup/length of femur
- The CV of the parameters was in the range of 1.98% to 12.09%

Morphometric parameters

		Mean	CV (%)
Height at:	***Withers (A8)***	136,34	2,22
	Back (A9)	129,75	2,17
	Croup (A10)	131,22	2,32
Length of:	***Head***	54,81	2,98
	Neck	64,89	4,59
	Back (A9-A10)	57,33	6,74
	Humerus (A6-A7)	28,78	6,45
	Scapula (A7-A8)	53,94	3,95
	Croup (P9-P10)	47,23	4,18
	Femur (P7-P8)	37,71	4,39
Width of:	***Breast***	33,79	10,86
	Pelvis	43,02	6,89

Morphometric parameters

		Mean	CV (%)
Angles	Shoulder joint	104,8	5,36
	Inclination of scapula	56,3	6,02
	Inclination of humerus	47,3	7,84
	Hip joint	85,43	5,37
	Inclination of pelvis	20,69	10,03
	Femur to the horizontal plane	62,99	6,53

Repeatability

- When the ***same image*** was tracked two times
  - Height parameters: 0.97 (0.80-1.00)
  - Segment lengths: 0.83 (0.67-0.97)
  - Angles 0.84: (0.67-0.99)
- When the ***left and right side*** of the same horse were tracked
  - Height parameters: 0.85 (0.71-0.95)
  - Segment lengths: 0.82 (0.67-0.96)
  - Angles 0.87: (0.80-0.96)

Discussion

- A 3-D, detailed and objective description of conformation
- Filming is very fast (no skin markers)
- The horses are filmed while walking
  - Not photographed while standing
    - An advantage that comes with not having to stand the horses in a repeatable way
- Manual placement of anatomical landmarks is rather time consuming

Discussion

- Rather high repeatability in general
- Lower repeatability of height parameters when left and right side of the same horse were tracked
- The anatomical landmarks that were the most difficult to track consistently were:
  - Point of shoulder
  - Summit of the femur and
  - Point of buttock

Future research

- Regarding the repeatability
  - Track the same horse from the left and right when the same image has been turned
  - Track the same horse at different locations within the frame
- Track distal anatomical landmarks (finish each horse)
- Relate the 3-D measurements to riding ability and conformation scores(track more horses – images of ca. 300 horses available)