HABIT: Horse Automated Behaviour Identification Tool – A Position Paper

Figure 1: HABIT Project logo

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Abstract

HABIT (Horse Automated Behaviour Identification Tool) is an Animal Computer Interaction (ACI) project, on the interdisciplinary boundary between equitation science and computer science. HABIT will automate the analysis and recognition of horse-to-horse and horse-to-human behaviours, as observed in unconstrained / ad-hoc video. A horse-to-horse dyad video dataset will be compiled, illustrating exemplar behaviours. Behavioural signatures will be manually identified from video. Next, a system will be developed and trained to recognise these signatures. The tool will then be evaluated, when applied to both horse-to-horse and horse-to-human video clips. In the study of animal behaviour, an 'ethogram' is a set of comprehensive descriptions of the characteristic behaviour patterns of a species. HABIT is potentially the first step towards the 'automated ethogram'. This project provides a welfare-orientated approach to evaluating horse behaviours. When horses are handled, trained or ridden, HABIT will help ensure that these experiences occur within the natural repertoire of equine behaviours. There is also scope to engage and educate the public about horse behaviours; both for general interest and to raise welfare-awareness. Additionally, automation could play an important methodological role in animal-centred design by reducing human biases during the requirements and evaluation processes.

Figure 2: Mock-up of HABIT system interface, identifying and tracking individual horses in a herd

Author Keywords
ACI; animal behavior; automated behaviour identification; automated ethogram; equine; equitation science; ethology; horse.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous
H.5.1 Multimedia Information Systems (video)
I.2.10 Vision and Scene Understanding (Motion & Video analysis)
I.4.8 IMAGE PROCESSING AND COMPUTER VISION: Scene Analysis (Motion & Object recognition)

Introduction

The authors are currently in the exploratory stages of HABIT (we are calling this HABIT 0.5). We have been funded to further develop our ideas and to build the 'discipline bridging network' that has brought us together. Our joint expertise covers equitation science [7][8], animal behaviour, ethology, veterinary science, video [12] and human computer interaction (HCI). As such, we find that ACI (animal computer interaction) [3][4][5][6] offers an exciting domain, perfectly describing our interdisciplinary focus on both animal and computer sciences.

ACI addresses the interaction between animals and technology, and designing user-centred technology for and with animals. The HABIT project [9][10][11] (see Figure 1) falls within ACI as it develops user-centered technology that supports animals and interspecies relationships. The full HABIT project (once developed beyond its current 0.5 exploratory stage) will investigate the use of computers to automatically recognise horse behaviours from video (see Figure 2, for a mock-up of the interface). Subsequently the developed system will be enhanced to recognise horses interacting with humans. This opens up exciting possibilities for evaluating the welfare of horses when being trained, handled and ridden by humans. For example, it may be possible to identify even very subtle signs of pain in the horse.

There is also potential to develop both the public engagement and education aspects of HABIT's autmated behaviour identification. This could be made available to a wide audience of both animal owners and related professionals (e.g. veterinarians, animal care, welfare staff etc.).

Moreover, within ACI, the automatic recognition of animals' spontaneous behaviour, including animal-animal and human-animal interactions, has an important methodological role to play in the implementation of animal-centred design processes. In particular, the proposed system will enable designers to reduce human biases during the elicitation of requirements for and the evaluation of ACI applications.

Aim and objectives

The Aim of this project is to develop a video-based automated behaviour identification software tool for observations of both horse-to-horse and horse-to-human interaction.

HABIT's objectives are as follows:

(i) To develop (or refine existing) computer algorithms for automatic identification, tracking and behavioural recognition of horses in video recordings.

(ii) To establish video datasets of horse-to-horse and horse-to-human behaviours.

(iii) To evaluate the developed algorithms and software tool, seeking statistically significant rates of behaviour detection for: 'BEHAVIOUR PRESENT' and "BEHAVIOUR NOT PRESENT".

iv) To evaluate the potential for future applications of HABIT in the study of horse behaviour and as an automated means of providing feedback on ridden behaviour that could be used as a training aid and potentially as a means of assessing equine performance from a welfare perspective.
v) To evaluate the potential of automated behavioural detection as a methodological tool in animal-centred design, particularly when eliciting requirements for and evaluating ACI applications.
vi) To evaluate HABIT as a tool for encouraging public engagement and education.

Technical considerations

One of the first work packages in HABIT will be a Technology Review. Relevant technologies for further investigation might include: Bayesian Target Tracking and the Motion Parameter Sharing (MPS) algorithm. These are both used for tracking moving objects, while retaining knowledge about the target object's neighbours. In 'Automated Image-Based Tracking and Its Application in Ecology' [2], Dell et al.'s excellent review of existing research illustrates how HABIT will push the boundaries of the current state-of-the-art. This is because HABIT requires tracking that will work:

- in the field (rather than only the laboratory)
- in a complex habitat (variable backgrounds and vegetation)
- with many individuals (horses and humans)
- with the identities maintained (of individual horses and humans)
- with detailed poses (not just the position, but relatively subtle changes of posture - ears, head carriage, tail etc.).

One project in which the technology comes very close to the requirements for HABIT is Zeppelzauer et al.'s 'automated detection of elephants in wildlife video'. The authors describe their work as: "a sound basis for higher-level analysis tasks, from the automated estimation of group sizes, to the identification of animals, and to the automated recognition of different activities and behaviors." [13, p.23]. One limitation would appear to be this technology's reliance on a species with generalised body colouration (elephant – grey). This makes Zeppelzauer's animals easier to track than horses, which may feature a wide variation of both coat colour and pattern.

Conclusions

The authors believe that this project offers a unique opportunity to study both species and interspecies behaviour, combining the latest research from the domains of equitation science and human computer interaction. It also offers important welfare advantages for domesticated horses. Automating behaviour identification provides a more evidence-based approach to observing interactions between horses and humans. This allows us to consider: when horses are handled, trained or ridden, are these experiences always within their natural repertoire of behaviours? If not, we might want to modify those interactions that are causing them stress, or even attempt to introduce behaviours that model those found within their ethogram. From the same animal-centred perspective, automated behaviour identification could be methodologically invaluable when designing ACI applications.
Beyond the automated identification of horse behaviours, we see that there is a recognised need for video-analysis technologies, such as HABIT in other fields. For example, in HCI tools are needed: "to support the identification of salient features to analyse in system recordings (e.g., conversational

threads)...[and]...the extraction of salient features from system recordings so that discrete sequences of interaction may be described and analyzed" " [1, p.9].

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