

# Charting Unconquered Territories: Intelligent Systems for Animal Welfare

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**Abstract.** In introducing the First Symposium of Intelligent Systems for Animal Welfare, we share our vision for a new multidisciplinary field of animal welfare informatics, in which scholars from artificial intelligence, computer science, animal science, veterinary medicine and other fields join efforts to exploit state-of-the-art technologies for the improvement of animal welfare.

## 1 Animal Welfare

The digital era has revolutionized our quality of life in every possible aspect. Intelligent systems which help us make better decisions, analyze big data and manage complex information are omnipresent in healthcare, education, commerce and many other fields. But are the recent developments realizing their full potential in a similar way in the lives of animals? Can we take advantage of state-of-the-art scientific achievements in informatics and artificial intelligence to improve animal welfare? What constitutes good welfare for animals is the object of ongoing research within animal welfare science (e.g., [10]). Generally, basic health and physiological functions, affective states and the ability to express adapted behaviour are considered important parameters for welfare assessment (e.g., [6]). In terms of welfare standards, these dimensions are expressed by the following principles of the Five Freedoms ([9, 1]):

1. Freedom from hunger or thirst by ready access to fresh water and a diet to maintain full health and vigour;
2. Freedom from discomfort by providing an appropriate environment including shelter and a comfortable resting area;
3. Freedom from pain, injury or disease by prevention or rapid diagnosis and treatment;
4. Freedom to express (most) normal behaviour by providing sufficient space, proper facilities and company of the animal's own kind;
5. Freedom from fear and distress by ensuring conditions and treatment which avoid mental suffering.

Originated from a UK Government report on livestock husbandry and subsequently developed by the British Farm Animal Welfare Advisory Committee, the Five Freedoms have since then been the base of animal welfare standards defined by economic, scientific and advocacy organisations as diverse as the World Organisation for Animal Health, the American Veterinary Medical Association, the Royal Society for the Prevention of Cruelty to Animals, to name just a few.

The above principles pose specific challenges for human practices and their relations with animals. In particular, new scientific discoveries increasingly highlight the complexity of animals physiological

and psychological characteristics and welfare requirements. At the same time, the issue of animal welfare is of growing concern to many areas of society. Therefore there is a need for researchers to intensify efforts aimed at improving the welfare of other beings in our dealings with them.

## 2 Introducing ISAWEL'14

In initiating ISAWEL, a symposium on Intelligent Systems for Animal Welfare, our aim was to bring together animal scientists, who could provide expertise on welfare problems, and computer scientists, who could provide insights into their possible technological solutions. Our vision was to establish an ongoing interdisciplinary dialogue to advance both animal welfare science on a computational trajectory and the science of intelligent technology beyond humans. As a starting point, this first edition of the symposium, ISAWEL14, brings together research areas of Animal-Computer Interaction, neural networks and robotics through papers which are authored both by animal experts and computer scientists.

The emerging area of Animal-Computer Interaction (ACI) [8] aims to develop a user-centred approach to the design of technology intended for animals. ACI's mission is to expand the boundaries of interaction design and the design of interactive systems beyond the human species. Its aims include investigating the interaction between animals and technology, designing technology to support animals in different contexts, and developing user-centred approaches to the design of technology intended for *more-than-human* animals [7]. ACI has the potential to improve animal welfare in a variety of ways: for example, by affording them more control over their own environment (see ISAWEL14 paper by Mancini et al.) thus enabling the fulfilment of their physiological needs as they arise; by providing them with cognitive enrichment (e.g. see ISAWEL14 paper by French et al.) thus promoting the expression of more natural behavior; or by supporting them in tasks they are employed to do (e.g. see ISAWEL14 paper by Robinson et al.) thus alleviating stress and distress.

As opposed to ACI, the field of artificial neural networks (ANNs) has been present in AI for several decades. ANNs are computational models inspired by animals' central nervous systems (in particular the brain) that are capable of machine learning and pattern recognition. In ISAWEL'14 paper by Barbuti et al., ANNs have been applied to assist the population growth of tortoises by an automatic identification of nesting phases.

Finally, in a paper by Gergely et al., artificial agents are applied for gaining insights into canine interaction with humans. Its authors are leading experts from Family Dog Project ([2]), the first research group dedicated to investigate the evolutionary and ethological foundations of dog-human relationship.

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Framing the symposium's five paper presentations, both keynotes given by distinguished scholars in computer science and animal behavior demonstrate or directly argue for the need to take a multidisciplinary approach in animal welfare research.

The opening keynote is by David Harel, William Sussman Professor of Mathematics at the Weizmann Institute of Science, a recipient of numerous prizes and distinctions, including the prestigious Israel and Emet Prizes. He has been working on a variety of topics within computer science, including modeling and analysis of biological systems. His keynote demonstrates the fruitfulness of computational approaches when studying and modelling complex systems, such as the behavior of animal populations, which is critical for understanding their welfare requirements.

The closing keynote is given by Shaun Lawson and Daniel Mills. Daniel Mills is Professor of Veterinary Behavioural Medicine and Head of Research Strategy at the University of Lincoln's School of Life Sciences; he is a world-renowned expert in animal behaviour, and has made key contributions to welfare practices for, among others, horses, dogs and cats. Shaun Lawson is Professor of Social Computing and Director of Lincoln Social Computing Research Centre (LiSC) and Director of Research at the University of Lincoln's School of Computer Science; he has collaborated with Daniel Mills on numerous projects related to human-animal interactions. Their keynote highlights the importance of collaborating with animal welfare scientists when developing technological interventions intended for animal use.

To provide an opportunity for all symposium participants to take part in the multidisciplinary dialogue to which presentations and keynotes variously contribute, the programme includes a round table discussion on the themes emerged during the day.

### 3 Summary

As shown by the wide range of topics presented in these proceedings, multidisciplinary applications in animal welfare of methodologies and techniques from artificial intelligence, animal-computer interaction, robotics and intelligent systems are starting to emerge. We believe that the time is ripe to start building a new discourse between scholars from across a range of areas related to intelligent technologies and a range of areas pertaining to animal welfare to lay the foundations for a new discipline of *animal welfare informatics*.

### 4 Acknowledgements

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### REFERENCES

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