

ENVIRONMENT AND BEHAVIOR SYMPOSIUM

The Use of Computers for Modeling, Recognizing and Recording Behavior

7 Animats from the bottom up: virtual ethology in the real world. J. M. Watts, *University of Saskatchewan, Saskatoon.*

Animats are computer-simulated animals. Animat research (AR) employs ideas and techniques from artificial intelligence, cognitive science, ethology and other fields. I review some key concepts in AR and examine its present and possible future applications to the study of animal behaviour. AR has already been applied to real problems in livestock management. The use of simulated animals permits the development of computer models of animal behaviour which may be used for rapid and inexpensive evaluation of new livestock environments or management techniques. AR is a powerful heuristic, which can improve understanding of the mechanisms underlying behaviour through the creation of functional analogues of neural and behavioural processes. A distinction is often drawn between "top-down" and "bottom-up" approaches to AR. In top-down models the relevant behaviour and conditions required to perform it are encoded explicitly. Bottom-up models feature simple rules and capabilities, the resulting behaviour is emergent and sometimes unpredictable. Emergence is said to occur when animats exhibit properties which were not specifically programmed, these may be considered adaptive in the context of the simulation. Animat programs commonly employ artificial neural networks (ANNs). These are capable of learning and have been used for a range of behavioural functions from decision-making to control of individual limb movements. Simple, but complete, nervous systems have been simulated using ANNs. Genetic algorithms (GAs) are computer programs which are capable of reproducing. Sections of code from parent programs replicate using crossover and mutation. Animats incorporating GAs can evolve over generations. Selective forces may be provided by a human overseer or be integral to the simulated environment. The uses to which animats will be put in the study of animal behaviour will depend on the imaginations of ethologists and their willingness to embrace ideas that may be unfamiliar to many. Animats have significant value as tools for research and teaching of animal behaviour.

Key Words: Ethology, Artificial Intelligence, Animat

8 Computer-based investigations of the social and spacing behavior of confined animals. W. R. Stricklin^{1*}, J. Z. Zhou¹, and H. W. Gonyou², *¹University of Maryland, College Park and ²Prairie Swine Centre, Saskatoon, Canada.*

Starting in the 1970's, we have used computer simulations to gain an understanding of the spacing and movement patterns of confined animals. The work has progressed from the early stages that used only randomly positioned points to current investigations that use animats (computer simulated animals) that show low levels of learning using artificial neural networks. From the results of this work, we have determined that: 1) pens of equal floor area but of different shapes result in different spatial and movement patterns for randomly positioned and moving animats, 2) when group size increases under constant density, freedom of movement approaches an asymptote at approximately 6 animats, 3) matching the number of animats with the number of corners results in optimal freedom of movement for small groups of animats, and 4) perimeter positioning occurs in groups of animats maximizing their distance to first and second nearest neighbors. Recently, we developed animats that move, compete for social dominance, and are motivated to obtain resources (food, resting sites, etc.). We are currently developing an animat that learns its behavior from the spatial and movement data collected on live pigs. The animat model is then used to pre-test pen designs, followed by new pig spatial data fed into the animat model, resulting in a new pen design to be tested, etc. We believe that methodologies from artificial-life and artificial intelligence have much to offer our understanding of basic animal behavior principles, as well as application to solving problems in production agriculture in areas such as animal housing design.

Key Words: Animal Housing, Group Behavior, Computer Simulation

9 A Video database system for studying animal behavior. J. Morrow-Tesch^{1*}, J. Dailey¹, and H. Jiang², *¹USDA-ARS Livestock Behavior Research Unit, W. Lafayette and ²Purdue University, W. Lafayette, IN.*

Classification of farm animal behaviors are based upon oral or written descriptions of the activity that an animal is engaged in. The quantification of animal behavior for research requires that an individual recognize and code the behavior of the animal under study. The classification of these behaviors can be subjective and may differ among observers. Illustrated guides to animal behavior do not convey the motion associated with most behaviors. Video based guides offer a subjective method of quantifying behaviors with real time demonstrations of the components that make up a behavior. We will demonstrate an animal behavior video database system which is being developed to automatically extract animal motion information from the input animal activity video clip by a multi-object tracking and reasoning system. The extracted information is analyzed and described using a set of standard animal behavior definitions. The behavior description is used to automatically annotate a given video clip and serves as a content-based index. The user of the system is able to use a keyword description of the behavior to retrieve the corresponding video object. The intended applications of the system are animal and veterinary science education and animal behavior research.

Key Words: Animal Behavior; Video Database, Object Tracking, Video Indexing

10 Modeling swine housing effects that determine ambient conditions from control of varying weather conditions. D. L. Harris^{*}, J. E. Temple, and L. O. Pordesimo, *USDA-ARS, RLHUSMARC, Clay Center, NE.*

Previous swine modeling efforts focused on the interaction of feeding programs with potentials for animal growth. These emphasize accretion of tissue protein from ideal protein of the dietary intake and utilization of nonprotein energy for maintenance, support of tissue synthesis and accretion of lipid tissues. Additional efforts incorporated the influence of ambient temperature upon digestible energy intake, which thereby controls intake of other nutrients, with subsequent major effects upon tissue accretion. To extend these efforts, another component model was developed to simulate how heating, ventilation and evaporative cooling capabilities of modern swine housing modify fluctuating temperature and humidity to determine ambient temperature and humidity and reduce fluctuations. Details of this latter model simulate the thermodynamic properties of moist air, requiring the programming of psychrometric relations among the physical and thermal properties of a mixture of air and water vapor. These equations have been incorporated into a user-friendly computer program, so a user may interactively specify heating, ventilation and evaporative cooling capabilities and adjust thermostat settings to yield specifications for housing options capable of controlling ambient conditions within desired ranges despite the variability of weather conditions. Thus, the software can be a decision aid to managers when designing swine housing by determining needed capacity for fan, heater and evaporative cooling. Also, in a functional building, appropriate thermostat settings may be determined for specific comfort zones of swine populations. The program was developed in Microsoft Excel for Windows 95 and will be adapted to function in Windows 3.X or higher, though larger memory and faster microprocessors will improve performance. In addition to this stand-alone model, the same algorithm will be applied in a larger herd-level model of total pork production systems.

Key Words: Pork Production, Environmental Control, Animal Housing