

Wildlife surveillance using GPS: From movement tracking to behavior recognition

Workshop during:

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Organized by:

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Theme

Understanding the individual and social behavior of wild animals in the context of their habitat is imperative to protect and increase biodiversity. Our ability to observe individuals in the wild has increased exponentially with the availability of GPS. The increased miniaturization and prolonged operation time of GPS receivers and loggers allows us to consider new ways of analyzing and influencing animal behavior.

Rationale

Around the globe, initiatives are undertaken to protect and - where possible - increase biodiversity. The declaration of 2010 as the International Year of Biodiversity by the United Nations illustrates that governments support the importance of biodiversity as a prerequisite for science, economy and society. For example, 'ecological corridors' and 'ecoducts' are constructed to increase freedom of movement for wildlife, to prevent splitting of populations, and to optimize the integration of nature conservation, agriculture and recreation. However, this can also lead to unwanted confrontations between humans and animals (e.g. traffic incidents), damage to crops, and the spreading of diseases between wildlife and farm animals.

Until recently, available technology (like radio tracking and satellite tracking techniques) suffered from limited temporal and spatial resolution, resulting in position data that are too coarse to determine how animals behave relative to the environment and each other. In other words: it tells you where the animal is but not what it is doing. Furthermore, the size and weight of transmitters and batteries made them unsuitable for small animals.

Workshop Objectives

GPS technology allows moving objects to be tracked at small time intervals, and spatial resolution has improved dramatically over the years. However, analysis tools able to process large streams of GPS data and to convert spatial coordinates into behavioral parameters are still lacking. New approaches to extracting information and transforming it into knowledge have to be found. Furthermore, by adopting concepts from the field of artificial intelligence, GPS tracking can be extended with real-time data processing, interpretation and feedback, offering fascinating new opportunities for wildlife management and disease control. The objective of this workshop is to discuss the state-of-the-art, exchange practical experiences and define a first set of requirements towards a GPS-based behavior measurement and wildlife management system.

Workshop Program

The workshop will consist of four technical topics:

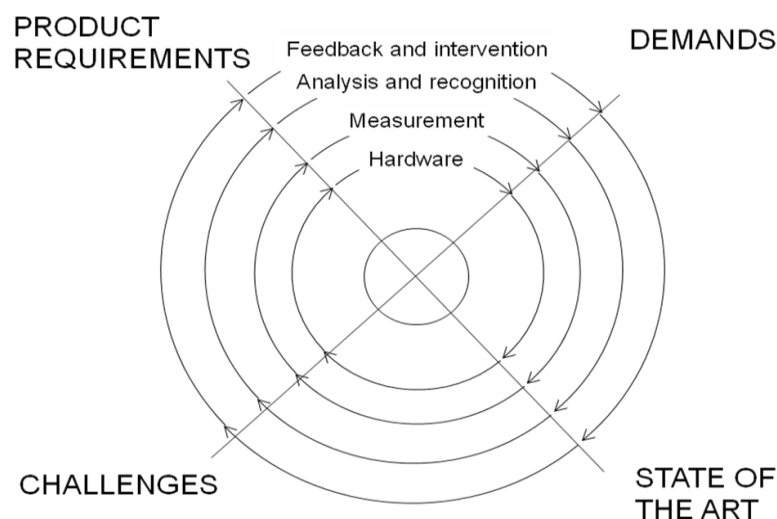
1. **Measurement:** what to measure (location, time, physiological signals, ambient variables) and how. This includes (non-exhaustive list):
 - Possibilities of GPS relative to radio tracking and satellite tracking
 - Logging versus real-time transmission of location data

- Temporal and spatial resolution: what can be achieved?
 - GPS tracking under challenging conditions
 - Integration of movement data with ambient parameters or physiological signals
2. Analysis: processing of position data and other variables into behavior recognition. This includes (non-exhaustive list):
 - Algorithms for location-based event recognition
 - Algorithms for behavior recognition and movement track segmentation
 - Integration of GPS data analysis and GIS systems
 - Software tools for analysis of movement patterns, individual behavior and interactions
 3. Feedback & Intervention: closing the loop, from real-time processing to feedback, guidance and control. This includes (non-exhaustive list):
 - Real-time data reduction, analysis
 - Feedback to the animal: guidance systems
 - Feedback to the environment: control systems
 4. Hardware aspects: energy issues, robustness, size (miniaturization), weight, etc. This includes (non-exhaustive list):
 - Size and weight of GPS loggers
 - Battery life, duration of measurements
 - Impact of hardware on animal behavior and welfare

Each topic is important for GPS-based behavior analysis and guidance systems, but has individual characteristics and progress. Prior to the workshop a market survey is performed to gather information about current practices, experiences, applications, and requirements for future technology. The discussion of each topic will start with the analysis of the market survey. This is followed by a discussion on the state-of-the-art in this topic: where do we stand today, what is technically possible? Based on this the challenges based on user needs are defined: what lies ahead of us, which questions need to be answered, which technical hurdles must be taken? These are translated into the final step: product requirements for GPS based behavior measurement, analysis and feedback systems. What should a measurement, analysis of feedback system be able to do?

Workshop Scope

Although the workshop is primarily targeted at wildlife, advances and lessons learned in animal husbandry and free-ranging cattle among others are welcomed as that application domain has similar requirements towards the behavior analysis system.



The workshop topics (hardware, measurement, analysis and feedback) are all discussed in 4 aspects: Results of the market survey, state-of-the-art, challenges and the product requirements.

Workshop Agenda

The workshop will take place on 25, 26 or 27 August (pending scheduling by the MB 2010 organizers). The half-day program (duration: 4 hours) is structured as follows:

- Welcome and introduction (15 minutes)
- Topic 1: Measurement (45 minutes)
- Topic 2: Analysis (45 minutes)
- Demonstrations of hardware & software (30 minutes)
- Topic 3: Feedback & Intervention (45 minutes)
- Topic 4: Hardware aspects (45 minutes)
- Wrap-up: conclusions and follow-up activities (15 minutes)

This workshop brings together academic researchers, practitioners and technology providers (including hardware and software vendors) discussing techniques and tools for wildlife movement tracking, data processing and analysis. We will present the state-of-the-art, exchange practical experiences and discuss future challenges. Participants are invited to share their own research results and experience from field studies. Demonstrations of hardware and software are welcome too. We would like to initiate a lively discussion on the topics listed above. Attending this workshop will provide participants with a better understanding of the possibilities, limitations and future research directions of wildlife surveillance using GPS technology.

Call for Participation and Position Papers

This half-day workshop is open to all registered delegates of the *Measuring Behavior 2010* conference. Prospective participants are requested to submit a 'position paper' beforehand, containing their views, experiences and user needs for animal behavior systems based on GPS technology. This will guarantee that participants are ready to participate in an active manner, and do not just attend in order to consume information passively. The position papers will not be published in the conference proceedings. This way, authors are free to present their ideas and latest developments without prejudicing future publications and without the need for the hard proof required for a reviewed paper. The papers will be used in a summary presentation on each topic. Position papers must be submitted to the workshop organizers before July 1, 2010. The maximum number of participants is 30; the workshop organizers reserve the right to select participants on the basis of position papers received.

Guidelines for Position Papers

Position papers enable discussion on emerging topics without the experimentation and original research normally present in an academic paper. Commonly, such a document will substantiate the opinions or positions put forward with evidence from a discussion of the topic. Central to the idea is your viewpoint on the issue. For our workshop we have identified 4 issues (see workshop topics), namely (1) measurement, (2) analysis, (3) feedback & intervention and (4) hardware. The aim of the position paper is to inform the other participants of your position as a starting point for discussion and a foundation to build resolution to difficult problems. The resolution will follow from the group discussions and the follow-up after the workshop. The position paper will function as a short and concise description of your (or your organization's) viewpoint on needs, priorities and solutions on the issues that we identified (see workshop topics). The position paper will allow other workshop participants to prepare for their own opinion on the needs, priorities and solutions. They will be circulated ultimately four weeks before the workshop takes place.

To create your position paper, simply fill out the questionnaire below, paste the completed form into an email message and submit it to the organizers, c/o Ms. Yvonne Leander (y.leander@noldus.nl) before July 1, 2010. This gives the organizers time to collate the different opinions so that the secretariat can circulate them to the participants four weeks before the workshop (notice: many people will be on summer vacation so extra time is needed).

Position Paper: Questionnaire

- Your name, organization, contact details
- Your experience with GPS measurement and data analysis. Are you using GPS loggers and GPS data? If yes, in what way? (e.g. technical development; application; which animal species, research question)
- Topic you wish to address: Measurement / Analysis / Feedback & Intervention / Hardware
- What do you consider the main issues concerning this topic? (current problems, shortcomings, challenges)
- Describe your solution or approach to solving the concerns, if you are able to so. For underpinning your opinion you can provide factual knowledge, statistical evidence or experimental outcomes but authoritative testimony can be of much use too. If based on your opinion “only”, please provide insight in your reasoning. Add relevant URL links.
- Will you bring a hardware or software product or prototype for demonstration during the workshop? If so, please provide a description.
- What do you expect from this workshop?
- Please provide names and e-mail addresses of others who should be informed about this workshop.
- Note: don't forget to register for the conference at www.measuringbehavior.org.