Decision-theoretic Planning under Uncertainty for Active Cooperative Perception

The research group AASS arranges a seminar with Matthijs Spaan, Institute for Systems and Robotics, Instituto Superior Técnico, Lisbon, Portugal.

When: Monday, November 2, 2009 at 14:15
Where: T131, Teknikhuset

Abstract
As robots leave research labs to operate more often in human-inhabited, larger environments, cooperation between sensor networks and mobile robots becomes crucial. For example, in urban scenarios, employing mobile robots is a need to augment the limited sensor coverage and improve detection and tracking accuracy. The fusion of sensory information between fixed surveillance cameras and each robot, with the goal of maximizing the amount and quality of perceptual information available to the system can be called cooperative perception. A promising decision-theoretic planning framework for cooperative active perception is that of Partially Observable Markov Decision Processes (POMDPs). The suitability of POMDPs for the previously depicted scenario arises from their ability to inherently trade off task completion, which could be react to a potential event that has been detected, and information gathering in an efficient way, that is decide to send a robot to improve situational awareness. In this talk we will discuss how planning under uncertainty can be applied to active cooperative perception problems.
Cognitive environment modelling and selective attention

The research group AASS arranges a seminar with Prof. Dr. rer. nat. habil. **Paul Levi**, IPVS, Stuttgart University.

**When:** Monday, October 26, 2009, 13:15  
**Where:** T135, Teknikhuset

### Abstract

The first part of this talk is devoted to the scientific roots and topics of cognition applied to deliberative agents that are called team robots in order to distinguish them from swarm robots. Here in the beginning of the talk the initial situation concerning the complexity of real world, the dynamics of e.g. environmental conditions and of the additional requirements of real time activities are discussed. An important terminology in applying cognitive mechanisms is the distinction between inaccuracy, uncertainty, trustiness, etc. of sensor data, of context-awareness data, and of situation predictions that all together are summarized to the concept of degraded information. A basic context quality example of a production process will be utilized to describe the mechanisms of cognition using degraded information.

The second block of this contribution is devoted to the presentation of a series of national and international supported projects whose topics are tightly connected to the deployment of cognitive techniques in production processes (car assembling, car coating), in traffic applications (autonomous cars, driver assistant systems, traffic management). This concentration of vehicle-oriented projects is not really astonishing, since Stuttgart is strongly connected with the producing automotive industry (Daimler, Porsche) and many component supplying companies (e.g. Bosch).

The second part ends with the description of a worldwide learning concept for robots that is initiated by Google Europe and Philips (Eindhoven) and has nothing to do with car manufacturing, but is roughly speaking aligned with the new idea that robots can also "google" e.g. for action plans and not only persons.
Abstract

In this talk I introduce a statistical method to build two-dimensional gas distribution maps (Kernel DM+V/W algorithm). In addition to gas sensor measurements, the proposed method also takes into account wind information by modeling the information content of the gas sensor measurements as a bivariate Gaussian kernel whose shape depends on the measured wind vector. We evaluate the method based on real measurements in an outdoor environment obtained with a mobile robot that was equipped with gas sensors and an ultrasonic anemometer for wind measurements. As a measure of the model quality we compute how well unseen measurements are predicted in terms of the data likelihood.
Time-of-Flight cameras for robotic applications

The research group AASS arranges a seminar with Dr. Stefan May.

**When:** Monday, October 19, 2009 at 13:15  
**Where:** T135, Teknikhuset

**Abstract**

The dealing with environment dynamics, while performing electro-optical range measurements, is a problem statement comprising the consideration of motion, changes in illumination, a high dynamic range in object reflectivity and dynamics with respect to the working range. Many robotic applications can benefit from robust 3D measurements available in real-time, e.g., 3D mapping or manipulation tasks. Time-of-Flight cameras might constitute a key enabling technology for those applications. A detailed analysis is provided in terms of improving accuracy, precision and robustness of related devices. Camera control and calibration is addressed as well as the need for filtering, both necessary to establish the profitable use in autonomous robotics. This is demonstrated by means of applying range image registration techniques in order to perform ego motion estimation.
Two talks for IROS - Dry-Run

The research group AASS arranges a seminar with Marco Trinciavelli, AASS Mobile Robotics Lab.

When: Wednesday, September 23, 2009 at 13:00
Where: T1210 (AASS meeting room), Teknikhuset

Abstracts

Talk 1:
Gas distribution modelling constitutes an ideal application area for mobile robots, which - as intelligent mobile gas sensors - offer several advantages compared to stationary sensor networks. In this paper we propose the Kernel DM+V algorithm to learn a statistical 2-d gas distribution model from a sequence of localized gas sensor measurements. The algorithm does not make strong assumptions about the sensing locations and can thus be applied on a mobile robot that is not primarily used for gas distribution monitoring, and also in the case of stationary measurements. Kernel DM+V treats distribution modelling as a density estimation problem. In contrast to most previous approaches, it models the variance in addition to the distribution mean. Estimating the predictive variance entails a significant improvement for gas distribution modelling since it allows to evaluate the model quality in terms of the data likelihood. This offers a solution to the problem of ground truth evaluation, which has always been a critical issue for gas distribution modelling. Estimating the predictive variance also provides the means to learn meta parameters and to suggest new measurement locations based on the current model. We derive the Kernel DM+V algorithm and present a method for learning the hyper-parameters. Based on real world data collected with a mobile robot we demonstrate the consistency of the obtained maps and present a quantitative comparison, in terms of the data likelihood of unseen samples, with an alternative approach that estimates the predictive variance.

Talk 2:
In this paper we investigate how a mobile robot equipped with tin dioxide gas sensors and an anemometer can use an online classification algorithm in order to improve the exploration strategy. The purpose of the platform is to establish the character of a gas source with accuracy while minimizing the time required for exploration. For this to be possible, the output of the classification algorithm is probabilistic, feeding in a sequence of posterior probabilities to a path planner. To further assist path planning, a 3d-ultrasonic anemometer is available which give indication on the average wind speed and direction. In addition to evaluating different olfaction driven path planning strategies, experimental validations also evaluate the classification algorithms and its application to different environments with varying characteristics.
A Human-Aware Robot Task Planner

The research group AASS arranges a seminar with Marcello Cirillo, AASS Mobile Robotics Lab. The presentation is a dry run for ICAPS 2009.

**When:** Wednesday, September 9, 2009 at 13:00  
**Where:** T1210 (AASS meeting room), Teknikhuset
Distributed Backpropagation-Decorrelation Learning for Fault Detection

The research group AASS arranges a seminar with Oliver Obst, PhD., CSIRO ICT Centre, Autonomous Systems Lab.

When: Friday, August 21, 2009 at 13:00
Where: T1210 (AASS meeting room), Teknikhuset

Abstract

In long-term deployments of sensor networks, monitoring the quality of gathered data is a critical issue. Over the time of deployment, exposure to harsh condition may cause sensors to degrade or to fail. If such a degradation remains undetected, the usefulness of a sensor network is greatly reduced. We introduce SODBPDC, a distributed recurrent network architecture, and a method to learn spatio-temporal correlations between different sensors for fault detection in a distributed way. Our approach is evaluated using real sensor network data, and proves to work well with less-than-perfect link qualities and more than 50% of failed sensors.
Scanning While Moving

The research group AASS arranges a seminar with Benoit Dolives, Université Paul Sabatier, Toulouse, France, who will report about his M.Sc. project.

**When:** Friday, August 14, 2009 at 13:00

**Where:** T1210 (AASS meeting room), Teknikhuset
Two dry runs for IE 2009

The research group AASS arranges a seminar with Marcello Cirillo and Marios Daoutis from AASS Mobile Robotics Lab. Marcello will present "Monitoring Domestic Activities with Temporal Constraints and Components" and Marios "Integrating Common Sense in Physically Embedded Intelligent Systems", both are dry runs for IE 2009.

When: Thursday, July 16, 2009 at 14:00
Where: T1210 (AASS meeting room), Teknikhuset
Two dry runs for ICAR-09

The research group AASS arranges a seminar with Marcello Cirillo, AASS Mobile Robotics Lab, and Todor Stoyanov, AASS Learning Systems Lab. Marcello will present "Human-Aware Task Planning for Mobile Robots" and Todor "Maximum Likelihood Point Cloud Acquisition from a Mobile Platform", both are dry runs for ICAR-09.

**When:** Wednesday, June 17, 2009 at 14:00

**Where:** T1210 (AASS meeting room), Teknikhuset
A Probabilistic Approach to Distributed (Odor) Source Localization

The research group AASS arranges a seminar with Thomas Lochmatter, DISAL Group, EPFL Lausanne, Switzerland.

**When:** Monday, June 15, 2009 at 13:00  
**Where:** T131, Teknikhuset

**Abstract**

Odor source localization (i.e. finding a source that releases chemicals with a mobile robot) was traditionally done with bio-inspired algorithms. Such algorithms are easy to implement, yield good results in simple environments, and need very little information about the environment and the source. If substantial prior information (e.g. a map, source characteristics, wind flow) is available, probabilistic approaches are more interesting, as they allow to combine all available information.

In this presentation, I will show on the example of localizing an odor source how probabilistic models can be used for search with a robotic sensor network. The talk will also show the relationship with optimal node placement in sensor networks - an interesting link between pure sensor networks and robotic sensor network.
Grasp-related features extraction by human dual-hand object exploration

The research group AASS arranges a seminar with Krzysztof Charusta, AASS Learning Systems Lab.

**When:** Wednesday, June 10, 2009 at 14:00  
**Where:** T-1210 (AASS seminar room), Teknikhuset

**Abstract**

NOTE: We consider the problem of objects exploration for grasping purposes, specifically in cases where vision based methods are not applicable. A novel dual-hand object exploration method is proposed that takes benefits from a human demonstration to enrich knowledge about an object. The user handles an object freely using both hands, without restricting the object pose. A set of grasp-related features obtained during exploration is demonstrated and utilized to generate grasp oriented bounding boxes that are basis for pre-grasp hypothesis. We believe that such exploration done in a natural and user friendly way creates important link between an operator intention and a robot action.
The Nao robot

The research group AASS arranges a seminar with Bruno Petit, Aldebaran Robotics.

When: Friday, May 29, 2009 at 9:00
Where: T101, Teknikhuset

Abstract

This presentation will serve as an overview of the humanoid robot Nao, developed and manufactured by Aldebaran Robotics SA, a young European company based in Paris, France. The live demonstration will consists in showing the robot interact autonomously and showing the capacities of high level programming through Choregraphe software.

Nao stands tall in all points amongst its robotic brethren. Platform agnostic, it can be programmed and controlled using Linux, Windows or Mac OS. The hardware has been built from the ground up with the latest technologies providing great fluidity in its movements and offering a wide range of sensors.

Nao contains an open framework which allows distributed software modules to interact together seamlessly. Depending on the user's expertise, Nao can be controlled via Choregraphe®, our user friendly behavior editor, by programming C++ modules, or by interacting with a rich API from scripting languages.

In addition to the high level API which allows users to make Nao walk and balance, advanced users can take advantage of low level access to sensors and actuators and can, if they wish, replace our code with custom adaptations. In order to allow users to validate motion sequences, simulators are available for Microsoft Robotics Studio and Webots.

COMPANY PROFILE: ALDEBARAN ROBOTICS was founded in 2005 in Paris to develop and market humanoid home robot companions.

Since May 2008, Aldebaran is shipping its first generation robot. Nao is a 58cm tall friendly robot that includes a computer and networking capability at its core. Delivered with a full set of development tools, NAO addresses the needs of universities including RoboCup players and research labs around the world. It's an evolving platform, which is unique in its ability to handle multiple applications.

Today Aldebaran's regroups 56 people including +35 first class engineers and PhDs involved in R&D and production. In January 2008, Aldebaran Robotics raised Series A financing of EUR 5 million led by CDC Innovation alongside I-Source Gestion.
Towards Strongly Cooperative Multi-Robot Teams: Dealing with Heterogeneity and Faulty Systems

The research group AASS arranges a seminar with Lynne Parker, University of Tennessee.

When: Friday, May 29, 2009 at 10:15
Where: T101, teknikhuset
From Space to Smart Homes: Constraint-Based Planning for Domestic Assistance

The research group AASS arranges a seminar with Federico Pecora, AASS Mobile Robotics Lab.

**When:** Wednesday, May 20, 2009 at 16:15  
**Where:** T-1210 (AASS seminar room), Teknikhuset

**Abstract**

In this talk we present an architecture for concurrent activity recognition, planning and execution. The architecture builds upon OMPS, a constraint-based temporal reasoning framework. Originally conceived with space applications in mind, OMPS is a framework for developing decision support systems for temporal planning applications. We describe how the framework was extended to operate in a closed loop with physical sensing and actuation components in an intelligent environment. The talk will focus on the temporal knowledge representation and reasoning capabilities of the architecture, and describe an experimental run performed in real time in a deployed setting where sensors and robotic actuators provide proactive assistance to a human subject.
Navigating by Stigmergy: A Realization on an RFID Floor for Minimalistic Robots

The research group AASS arranges a seminar with Robert Johansson. The seminar will be a dry run of a paper presentation for ICRA-09. Abstract and paper: http://aass.oru.se/~asaffio/Papers/icra09.html.

When: Thursday, April 16, 2009 at 16:00
Where: T1210 (AASS meeting room), teknikhuset
Traffic Safety Services in Vehicular Networks

The research group AASS arranges a seminar with Kristoffer Lidström, Halmstad University. Kristoffer will present his Licentiate thesis results for us.

**When:** Monday, April 6, 2009 at 13:00  
**Where:** T205, Dept. of Technology

**Abstract**

The talk will present work carried out within the Vehicle Alert System (VAS) project at Halmstad University. The VAS project explores systems in which wireless vehicle-to-vehicle and vehicle-to-infrastructure communication act as enablers for a new generation of cooperative traffic safety functions. The use of unreliable wireless communication in traffic safety systems poses problems that must be addressed also beyond the link and network layers. The presented work deals with application- and middleware-level methods and strategies for reliably providing traffic safety applications in vehicular networks. On-line, site-specific measurements of radio channel quality as well as traffic coordination strategies that are robust against communication failures will be presented and evaluated.
Eye movements in attentive and command-and-control interfaces

The research group AASS arranges a seminar with Kari-Jouko Raiha University of Tampere, Finland.

When: Monday, February 16, 2009 at 13:00
Where: T225
Agricultural Robotics

The research group AASS arranges a seminar with Peter Biber - Robert Bosch GmbH, Germany (Corporate Sector Research and Advance Engineering, Future Systems for Industrial Technology, Consumer Goods and Building Technology)

When: Thursday, January 22, 2009 at 11:00
Where: T117, Dept. of Technology

Abstract

Electronics, communications and sensor technologies are strongly pushing innovations in agriculture and have become key technologies in this field thereby offering options for economical as well as ecological benefits. Recently, increased research activities have been started to develop autonomous field robots for future applications in agriculture.

In my talk, I will focus on the key technologies needed to build such robots and on potential applications.