BOĞAZİÇİ UNİVERSITY

Okan Aşık

Title: Using Genetic Algorithms for Solving Decentralized Multi-Agent Decision Making Problems

Abstract: An agent acting in an environment to achieve some goal requires a mechanism to evaluate the environment and to choose its actions accordingly. This mechanism can be modeled as Markov Decision Process (MDP). Policy is a solution to a decision making problem modeled as MDP. There are many efficient methods to compute a policy for single agent problems. However, the complexity of the optimal policy for multi-agent decision making problems is NEXP-Complete. Therefore, most of the research effort is focused on approximate methods.
We use an approximate policy search algorithm developed by Eker and Akın. The algorithm search policy space with the genetic algorithm. We represent policies as finite state controller and neural networks. The fitness of a policy is calculated by a simulator. We show that our method can learn effective policies in 2D robot soccer.

Yiğit Yıldırım (poster)

Title: Development of a Human-Aware Navigation System For Socially Assistive Robots

Abstract: Most of the fundamental navigation problems are solved due to an extensive research on the field of autonomous mobile robots. There are a great deal of path planning algorithms that enable robots to navigate through their surrounding environment in a safe manner. However, Human-Robot Interaction (HRI), suggests that, in addition to being safe, navigation of a robot must be understandable to humans, as well. Comprehensibility of the movements of robot increase its acceptance among humans. The concept of “human-aware navigation” refers to these shortcomings of the previous methods.
Social Force Model, introduced by Helbing and Molnar, was designed to describe human motion in a dynamic environment. We use this approach to develop a human-aware navigation module for socially assistive robots. The difference of this approach from fundamental path planning algorithms is represented. We also show that a more socially-acceptable motion is achieved in dynamic environments, on simulation.

Bahar Irfan (poster)

Title: Manipulation and Placement Planning for Loading a Dishwasher

Abstract:

In our daily lives, placing dishes into the dishwasher takes considerable amount of time and energy. In order to save the wasted time, we decided to develop a robot system which can autonomously detect the objects on the countertop and place them into the dishwasher.

The aim in this system is to maximize the number of mugs placed into the dishwasher by using minimum energy and minimum time for calculation and manipulation. There are three subproblems to solve for placing an object into a dishwasher: object recognition for detecting the mugs on the countertop and estimating their poses in order to find grasp positions; 2D packing problem for placing maximum number of mugs into the dishwasher without overlaps; placing the mugs into the dishwasher through manipulation. In this project, these tasks are solved in simulation environment, Gazebo, and in physical world by using 5 degree-of-freedom robot arm and 3D depth camera. Robot Operating System (ROS) is used in order to communicate with the robot. Object recognition and pose estimation are realized through the depth camera, which extracts depth image and point cloud data from the environment. Depth image is fed to the Histogram of Gradients method as a grayscale image in order to find the descriptors. 2-layer support vector machines is trained with these descriptors for detecting the object and detecting its pose. The dataset for training is taken through 3D depth camera at 60 degree angle using a turntable. The coordinates of the objects on the table are found from the point cloud data. For 2d packing problem, simulated annealing with the combination of next-fit and bottom-left-decreasing algorithms are used for arranging the objects inside the tray. The kinematics for manipulation is handled by MoveIt program. The tray is modeled as an empty box and the objects in concern are mugs. We showed that using simulated annealing instead of First Fit or First Fit Decreasing (nonincreasing-length, nonincreasing-width, nondecreasing-length and nondecreasing-width) algorithms increases the number of mugs placed in the tray.

UNIVERSİTY OF FREIBURG

Johannes Aldinger

Title: Complexity of Interval Relaxed Numeric Planning

Abstract: Automated planning is a hard problem which can not be solved directly. Delete relaxation heuristics are one of the predominant methods to obtain guidance in the original task. Numeric planning extends the planning framework by real-valued variables. The concept of a delete relaxation can be transferred to numeric planning tasks by enclosing the achievable values of a variable with an interval. We discuss the complexity issues that arise from such an interval relaxation method.

Moritz Göbelbecker

Title: Robot Task Planning and Explanation in Open and Uncertain Worlds

Abstract: Planning and acting under uncertainty is a long-standing challenge for AI and robotics. We use knowledge-level predicates and epistemic actions to translate uncertain beliefs into classical planning tasks in order to tackle several problems: planning with incomplete and uncertain knowledge, including planning in open worlds; finding explanations for task failures; and verifying those explanations.

Florian Geißer

Title: Delete Relaxations for Planning with State-Dependent Action Costs

Abstract: Most work in planning focuses on tasks with state-independent or even uniform action costs. However, supporting state-dependent action costs admits a more compact representation of many tasks. We investigate how to solve such tasks using heuristic search, with a focus on delete-relaxation heuristics. We first define a generalization of the additive heuristic to such tasks and then discuss different ways of computing it via compilations to tasks with state-independent action costs and more directly by modifying the relaxed planning graph. We evaluate these approaches theoretically and present an implementation of the additive heuristic for planning with state-dependent action costs. To our knowledge, this gives rise to the first approach able to handle even the hardest instances of the combinatorial Academic Advising domain from the International Probabilistic Planning Competition (IPPC) 2014.

Robert Mattmüller

Title: Cooperative Epistemic Multi-Agent Planning With Implicit Coordination

Abstract: Epistemic Planning has been used to achieve ontic and epistemic control in multi-agent situations. We extend the formalism to include perspective shifts, allowing us to define a class of cooperative problems in which both action planning and execution is done in a purely distributed fashion, meaning coordination is only allowed implicitly by means of the available epistemic actions. While this approach can be fruitfully applied to model

reasoning in some simple social situations, we also provide some benchmark applications to show that the concept is useful for multi-agent systems in practice.

Dali Sun

Title: A stable and robust localization method in dynamic and complex environments

Abstract: The localization problem is a fundamental problem for the autonomous mobile robot system. Although there are already many approaches used successfully in the static environment, but seldom are well suited for the high dynamic and complex environments, such as the intra logistic center or production hall. The major challenge of such environments is that the rapid changes occur irregularly. We consider such problems and present a stable and robust localization approach based on the Monto Carlo localization method for mobile robots in high dynamic and complex environments. At first, the dynamic objects are detected by a kind of a distance filter. Then, the robot position will be estimated by the Monto Carlo localization method which takes into consideration the dynamic objects detection. After that, the scan matching method will be invoked to improve and evaluate the quality of the pose estimated by the last step. If the quality reaches a curtain threshold, the occupancy map will be updated with a special probability model. Furthermore, to improve the robustness, we use the global scan matching method to find a initial position for the Monto Carlo localization, when a robot is just joining the environment, or when a robot is de-localized.

Christian Becker-Asano

Title: Embodiment, emotion, and chess: A system description

Abstract: We present a hybrid agent that combines robotic parts with 3D computer graphics to make playing chess against the computer more enjoyable. We built this multimodal autonomous robotic chess opponent under the assumption that the more life-like and physically present an agent is the more personal and potentially more effective the interaction will be. To maximize the life-likeness of the agent, a photo-realistic animation of a virtual agent's face is used to let the agent provide verbal and emotional feedback. For the latter an emotion simulation software module has been integrated to drive the agent's emotional facial expressions in parallel to its verbal utterances.

Yusra Alkhazraji (poster)

Title: Partial Order Reduction for Optimal Planning

Abstract: Planning as heuristic search is a leading approach to optimally solving domain independent planning problems. However, recent research has shown that there are significant and fundamental restrictions of pure heuristic search for optimal planning, even when almost perfect heuristics are available. Therefore, additional and orthogonal approaches to pure heuristic search are desirable to further improve the scalability of heuristic search based planning systems. Partial order reduction techniques have been traditionally applied to tackle the state explosion problem in the area of computer aided

verification. These techniques can reduce the size of the reachable state space by avoiding the application of independent transitions in redundant interleavings. The aim of this work is to investigate safe partial order reduction techniques that enhance the performance of heuristic search algorithms.

Andreas Hertle (poster)

Title: Planning and Action Control under Uncertainty for Mobile Manipulation Tasks

Stefan Wölfl (poster)

Title: TBD

Tim Schulte (poster)

Title: Distributed Multi-Agent Planning

UNIVERSITY OF ROME

Emanuele Bastianelli

Title: Making sense of Semantic Maps for robust Linguistic Interaction with Robots

Abstract: The last years have seen an increasing trend in producing robotic platforms as consumer products. Robots are slowly moving from industrial environments to consumer market and, in a near future, their presence in our houses as servant will become usual. In this perspective, providing robots with human-like interaction capabilities is a key aspect. Human language represents one of the most natural way of interaction, being a highly expressive, intuitive and exible interface. To this end, robotic platform should be provided with powerful Natural Language Understanding modules, capable of analyzing human language at every stage required for a complete interaction, from the Speech Recognition to deep Semantic Parsing. In the last decades, cognitive and psycho-linguistic studies have shown how there is a strict correlation between what we perceive and the interpretation we give to a sentence we hear or read. Modern robotic architectures are provided or equipped with sensors that enable for a deep analysis of the environment. Our work aim at demonstrating that the information coming from the perception systems of a robot (here condensed in a Semantic Map) can be used to enhance the interpretation ability of understanding natural language commands. Starting from a robust grounding function we devised, we show that information extracted from Semantic Maps are bene_cial to the interpretation process, improving the disambiguation ability of the learning algorithms that constitute our Natural Language Processing chain.

Maurilio Di Cicco

Title: Towards Self Calibrating Robots

Abstract: The usability of a robot relies on the accuracy of their world model and on the predictability of their actions. The world model, of a robot is estimated by integrating sensor measurements, and thus its accuracy depends on how these measurements are combined together. In a similar way, the success of plan execution depends on the predictability of the effects of its actions. Put in other words, to be usable a robot needs to be aware of the effects its actions have on the world model. Additionally to be able to refine its estimate about the world the robot needs to know how this estimate is mapped onto its sensor measurements. In my work i will focus mainly on mobile robots. Whereas the task they are required to address, which is moving from one point to another, might seem rather simple, setting up a system equipped with many sensors and actuators is complex procedure. To cross calibrate all the on board devices we will exploit the similarities between different sensors thus defining a common representation of the state. This common representation

led us to formulate prediction about the measurements that allow to relate heterogenuos sensors. Learning the motion model implies to correlate the effect of a actuator commands on the evolution of the system state. To this end we will analyze the effect of the variation in the perception that reflect a change in the system state. By extending the notion of state to include additional parameters we plan to cover with this learning procedure also in cases of faulty or non-nominal situations. At a subsequent stage we aim at learning also the structure of the model moving from a pure kinematic formulation to a richer dynamic one and finally leading to a generic, unsupervised generated one like using ANN. This will bring to a new way of working with robots, reducing the human management time, making them more robust to miscalibration and, in certain cases, even self-fault detecting and recovering.

My effort at the moment are focused on unsupervised, multi robot, multi sensor cross calibration via social learning and trajectory planning and control for mobile robots moving with reduced friction due to slippery surfaces/overactuation trained via machine learning.

Guglielmo Gemignani

Title: Teaching Robots Parametrized Executable Plans Through Spoken Interaction

Abstract: While operating in domestic environments, robots will necessarily face difficulties not envisioned by their developers at programming time. Moreover, the tasks to be performed by a robot will often have to be specialized and/or adapted to the needs of specific users and specific environments. Hence, learning how to operate by interacting with the user seems a key enabling feature to support the introduction of robots in everyday environments. In this paper we contribute a novel approach for learning, through the interaction with the user, task descriptions that are defined as a combination of primitive actions. The proposed approach makes a significant step forward by making task descriptions parametric with respect to domain specific semantic categories. Moreover, by mapping the task representation into a task representation language, we are able to express complex execution paradigms and to revise the learned tasks in a high-level fashion. The approach is evaluated in multiple practical applications with a service robot.

Fabio Previtali

Title: Distributed Interactive Navigation in Dynamic Environments through Intention-Aware Counterfactual Reasoning

Abstract: Many modern robotics applications require robots to function autonomously in dynamic environments including other decision making agents, such as people or other robots. This calls for fast and scalable interactive motion planning that is intention-aware. We present a real-time motion planning framework that brings together a few key components including an interactive motion model for other agents and counterfactual reasoning over possible movement intentions of other agents. This yields a light-weight iterative planner that enables fluid motion when avoiding pedestrians, in parallel with goal inference for longer range movement prediction. This motion planning framework is coupled with a novel distributed visual tracking method that provides reliable and robust models for

the current belief-state of the monitored environment. This combined approach represents a computationally efficient alternative to previously studied policy
learning methods that often require significant offline training or calibration and do not yet scale to densely populated environments. We validate this framework with experiments involving multi-robot and human-robot navigation. Also, we further validate the tracker component on unconstrained pedestrian data sets.

Francesco Riccio

Title: Context-Aware Multi-Robot Coordination

Abstract: In this paper, we consider several autonomous robots that need to coordinate to accomplish a common goal. Specifically, we assume that they are provided with a contextual knowledge about the scenario they operate in. To this end, we present a novel context-aware approach to coordination that allows the team to exploit this knowledge to enhance their overall performance. Our approach leverages principles borrowed both from the literature of multi-robot coordination and context-aware systems. We apply our context-aware coordination to the problem of locating a moving, non-adversarial target. In this specific application, multiple sub-areas of the environment are first ranked based on the provided contextual knowledge. The robots then coordinate adaptively to efficiently locate the moving target. The complete context-aware search approach runs on several robots. We report on experiments carried out with a team of humanoid robots in a soccer scenario and a team of mobile bases in an office environment.

Andrea Vanzo

Title: Combining grammar-based and statistical language models in hybrid ASR systems

Abstract: During the last decades, robots progressed from the very controlled industrial settings up to homes and social contexts. The ability of robots to interact with humans in ways that resemble human interaction became increasingly more relevant. Spoken Natural Language is probably the most flexible and intuitive way of communicating. To this respect, mobile service robots are expected to acquire and interpret vocal commands given by the humans. This observation is underlined by the effort spent in the recent years in recognizing the humans' speech and suggests that this aspect plays a crucial role in robotic systems. One method to deal with the problem of Automatic Speech Recognition (ASR) is to employ grammar-based decoders. Nevertheless, this approach can lead to a high number of false positives, especially when the grammar expressiveness covers a high amount of syntactic structures. On the other hand, statistical approaches for speech recognition use Hidden Markov Models, by modeling the problem as a N-gram decoder. This approach requires a high amount of data in order to acquire the language model. As a result, when the training set has been built by a single speaker, it tends to fit the speaker's speech. In the recent years, an increasing number of researchers tried to address speech recognition by combining these two methods.We propose a hybrid approach that combines grammar-based and N-gram decoders, by selecting the most likely solution from the two sets of hypotheses. Let

$H_G = \{h_1^G,...,h_l^G\}$ and $H_N = \{h_1^N,...,h_m^N\}$ be the hypotheses given by the grammar-based and the N-gram decoders, respectively. The two sets of utterances can be merged in a single set $H = H_G \cup H_N = \{h_1^G,...,h_l^G, h_1^N,...,h_l^N\}$ that contains all the hypotheses of the two decoders.

By introducing a re-ranking function $f_r(h_i^-,h_j^-)$ that works on pairs from this set, we are able to push up the most likely utterance and reward it as the selected transcription. This approach ensures that all the hypotheses can be equally evaluated. So that, there is no priority on the decoders, but the choice of the best transcription is done in a hypothesis-driven way.

UNIVERSITY OF GRONINGEN

Ilche Georgievski

Title: Hierarchical planning revisited, applied, and experienced

Abstract: Hierarchies are one of the most common structures used to understand and conceptualise the world. Within the field of Artificial Intelligence (AI) planning, which deals with the automation of world-relevant problems, Hierarchical Task Network (HTN) planning is the branch that represents and handles hierarchies. In particular, the requirement for rich domain knowledge to characterise the world enables HTN planning to be very useful, and also to perform well. We focus on the field of hierarchical planning from its beginning till nowadays. The history of almost 40 years obfuscates the current understanding of HTN planning in terms of accomplishments, planning models, similarities and differences among hierarchical planners, and its current and objective image. On top of these issues, the use of hierarchical planning in actual applications is always an interesting and challenging topic. We remedy these conditions and provide a comprehensive viewpoint on this core planning technique. Moreover, we demonstrate the application of and our experience in using hierarchical planning in a real environment of office buildings.

Frank Blaauw

Title: Personalized advice calculation using automated impulse response analysis.

Abstract: Personalization of mental healthcare research is receiving a plethora of attention nowadays. Although the majority of mental healthcare research focuses on group studies, the interest in research focussing on the individual is growing. The main reason for this increase in interest is attributable to the fact that group averages are not always sufficient or conclusions from these group studies might not hold for all individuals.
The present work describes AIRA, an algorithm and platform to automatically analyze intensive individual longitudinal data, using impulse response functions (IRF) and simulation. We show that intensive longitudinal data could be used to determine advice on measured psychological constructs, by analyzing the data using IRF. Our goal is to give insight into the way certain psychological constructs and other self-reported factors are connected and influence each other over time, and to provide advice on how these connections can be used to influence these psychological constructs.

We created a platform to perform an intensive longitudinal study on a large sample of the Dutch population. The data retrieved from this study are analyzed per individual, using a time series analysis method known as vector autoregression (VAR). The models created using this analysis technique are further analyzed by means of IRF. The resulting IRFs are used in simulations, to determine the optimal frequency and intensity of basic interventions, and show how psychological constructs can be influenced. The novelty of this work resides in the fact that automatically generating such a high level of advice on individual time series data using VAR and IRF has never been provided on such a large scale.

Faris Nizamic

Title: GreenMind - An Architecture and Realization for Energy Smart Buildings

Abstract: Existing buildings are responsible for more than 40% of the world's total primary energy consumption. Current building management systems fail to reduce unnecessary energy consumption and preserve user comfort at the same time mainly because they are unable to cope with dynamic changes caused by user's interaction with the environment. To cope with this dynamicity, we propose a software architecture for energy smart buildings that includes a set of concrete software solutions that tackle energy consumption subsystems, i.e., heating/cooling, lighting, workstations, and appliances, in order to save significant amount of energy whilst preserving user comfort. Experimental results carried out in the Bernoulli building, a 12.000 square meter building of the University of Groningen, show that the proposed solutions are able to save up to 56% of electricity used for lighting, at least 20% of electricity used for heating while the savings from controlling workstations as well as other appliances are 33% and 10%, respectively. Totally, our solution is expected to bring up to 28% of saving over total energy consumption in buildings such as the Bernoulli building.

Ilche Georgievski (poster)

Title: Theory and practice of hierarchical planning

Fatima Al Saif (poster)

Title: Tool to Improve the Performance of Instructors Based on Students' Feedback: A Case Study

Sha Ang (poster)

Title: Searching Energy in the Smart Grid