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Forest fire prevention and extinction (iWBB)
U. Borgolte, M. Gerke

The Control System Engineering group and Mechatronics group are engaged in the project *International forest fire combat*, which is supported by the Ministry of Economic Affairs and Energy of the State of Northrhine-Westphalia [1]. The project consortium consists of 5 companies, 2 universities, and 1 research institute. It started at the beginning of 2008 and has a duration of 24 months. The project is motivated by the fact that every year several thousand square kilometres of forest are destroyed by fire. For the mediterranean region alone, WWF estimates 8000 square kilometres every year.

Within the iWWB project, a technically advanced and more general system approach will be implemented and tested. This approach covers fire detection, fire fighting, rescue of persons, and fire aftercare, and it will be worked out by our research group and other project partners.

Here our blimp-type airship is intended to be used as a carrier of sensoric systems (heat/smoke/gas detection, pollution monitoring) and as relay station for wireless communication. Its advantages are the possibility to stay above ground for long periods of time and to be able to lift large payloads.

Together with micro-drones, it will be responsible for the following mission tasks:

- immediate inspection of suspicious areas, reconnaissance of passable access routes;
- establishment of a flying communication relais (airborne router);
- long-term monitoring of areas, where the fire is supposed to be extinguished.

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[1] *Verbundvorhaben iWBB:*
Proektfördernung durch das Ministerium für Wirtschaft, Mittelstand und Energie des Landes Nordrhein-Westfalen
Förderkennzeichen 213-81-01/01-08
Mine detection and removal (iMR)
U. Borgolte, M. Gerke

The Control System Engineering group and Mechatronics group are engaged in the project *International mine detection and removal*, which is supported by the Ministry of Economic Affairs and Energy of the State of Northrhine-Westphalia [1]. The project consortium consists of 7 companies, 2 Fraunhofer institutes, and 1 university partner. It started at the beginning of 2008 and has a duration of 24 months.

The project is motivated by the fact that large areas in the world are almost unlivable due to landmines. Within the iMR project, some new technical approaches will be implemented and tested by our research group and other project partners. These approaches cover both mine detection and mine removal. The blimp-type airship of our research group is intended to be used as a carrier of the sensoric systems. Its advantages are the possibility to stay above ground for long periods of time, to be able to lift larger payloads than mini-drones, and to exert no force to the ground while hovering in low altitude.

- Thus the first task of the blimp is to locate mines by appropriate sensorics.
- The second task is the inspection of the mine after its destruction to ensure that the mine is totally destroyed.

![Figure 1: Airship prototype](image1)

The control systems engineering group and the mechatronics group at FernUniversität are currently concentrating on the projects iWBB and iMR. The following 7 pages are describing different aspects of the project work.

[1] *Verbundvorhaben iMR / LASER:*
Projektförderung durch das Ministerium für Wirtschaft, Mittelstand und Energie des Landes Nordrhein-Westfalen
Förderkennzeichen 213-82-01/01-08
Dynamical Modeling of a Robotic Airship
O. Göller, I. Masár and M. Gerke

A basic flight control for a robotic airship can be set up with a Fuzzy rulebase for simple types of motion (e.g. stationary hovering with disturbances). However, the derivation of a complete mathematical model of the blimp dynamics is mandatory for the control of complex flight missions and for path planning. In general, the non-linear dynamic model of an airship, its geometric shape, its aerostatical and aerodynamical behavior, and its actuation system, have to be considered:

$$\mathbf{F} \frac{d\mathbf{x}}{dt} = \mathbf{C}(\mathbf{x}) + \mathbf{A}(\mathbf{x}) + \mathbf{G}(\lambda, \mathbf{W}, \mathbf{B}) + \mathbf{P}$$

A dynamical model of our Indoor-airship has been derived ([1],[2]) in a state-space representation regarding all physical effects occurring during flight. To provide a powerful simulation environment, the full dynamical model has been integrated into MATLAB/Simulink and it has been visualized by means of its Virtual Reality-Toolbox for controller development.

This work was presented on the 5th International Conference on Electrical and Power Engineering (EPE’2008), in Iasi, Romania, where Dr. Masár gave the Plenary Talk about our activities in flight robotics.

[1] Stefan Schnabel:
(in German),
Herleitung eines dynamischen Modells für ein Luftschiff unter Verwendung von MATLAB/Simulink
Diploma Thesis 2006, FernUniversität in Hagen

[2] Oswald Göller:
(in German)
Erstellung eines MATLAB/Simulink-basierten Virtual Reality-Modells zur Simulation des Flugverhaltens eines Luftschiffes
M.Sc. Thesis 2008, FernUniversität in Hagen
Marker based self-localization with a digital signal processor

H. Heinze

We utilize an autonomous airborne blimp as a sensor platform to support wildfire and land mine fighting. To assure easy manoeuvrability and handling, flight sensors and a tracking system for path-planning and trajectory validation are used. To support the staff and to protect the blimp against accidental collisions during take-off and landing operations, a self localization system is necessary.

To assure accurate positioning, besides conventional systems such as GPS and acceleration sensors, an image processing system for self-localization was tested. Encoded visual markers with known positions allow referencing with respect to the environment, therefore the position of the airship can be determined for all six degrees of freedom. By this way, a landing field can be flagged by such a marker, which can serve as a landing beacon. To implement such a marker tracking ability, the MATLAB augmented reality Toolbox was used as the basis of research. Future applications will have to manage the memory in a way, that high resolutions of video data are supported.

With increasing distance, accuracy and detection quality decrease, therefore the use at greater distances and heights is limited. For such situations, other systems on board the airship have to take the lead. Markers for image recognition are nowadays used in many forms. But there is no light-weight and energy saving system on the market. This can be achieved by use of a digital signal processor (DSP), particularly with fixed point arithmetics, that lower the cost and gain speed while offering low weight and low energy consumption. Focus of the research lies in the implementation of known algorithms for position detection, which are computable in real-time.

Figure 1: Self-localization and autonomous landing of a blimp


Path planning and mapping with autonomous and semi-autonomous aerial systems

U. Borgolte

Within the two ongoing projects iWBB and iMR, the PRT-blimp acts either as carrier for application-specific sensor systems or as relay station for communication between the control station and other mobile systems. Therefore, it is necessary to drive the blimp to a defined position in airspace and to be able to move it on a precalculated path in 3D-space with a given velocity. There are two reasons to take orientation into account. First, application sensors need to be aligned according to given values. Second, due to aerodynamical and actuation constraints, a proper direction towards the goal pose needs to be achieved. Thus, controllers for six degrees of freedom are to be developed.

Both stationary pose data and dynamic paths are defined with respect to the global earth coordinate system. Commands for movements are usually given with values taken from conventional geodetic maps (e.g. topographical maps). The 6D-feedback from the blimp about its current pose in space should be in a corresponding format. This is not only needed for control of the position/orientation and trajectory of the blimp, but also for referencing of the data from the application sensors.

Up to now, work is concentrated on identification of common data formats and appropriate software to access and manipulate map data. It is expected that commercial software will not cover all demands, therefore open source software is preferred. Position data needs to be exchanged with the control station, so it is necessary to use standardized map formats. Printed maps are not useful if automated processes are employed in the control station. Thus, digital maps are needed. There are two kinds of digital maps: digital raster graphics based and vector graphics based (fig. 1). The usage of a specific format is mainly determined by the availability of maps with a specified resolution.

In principle, maps open to the public as Google Maps can be used, but these are often out-dated and not sufficient with respect to resolution. Maps maintained by public bodies such as land surveying offices or military maps are better suited in most cases.

To make the best use of maps, access software needs to fulfill the following requirements: possibility to adapt to specific demands (open source), low cost, updating with own data, and integration into the control software of the blimp. The land surveying office of Hagen (Vermessungsamt Hagen) gives support for the decision on maps and software to be used.

Path Planning for Autonomous Flight Systems

Naef Al-Rashedi

Path planning for a robot flight system is very important within the Airship project, since the flight system should move only some meters above the ground. The main goals of path planning are:

1- Find a minimum path length for the airship to scan a specific area.
2- Avoid any unexpected objects and reach the destination without getting lost or crashing into any object.

To achieve these goals the path planner works into two phases:

1- Off-Line path planning: In this phase the path planner reads information from digital map for a specific area and uses genetic algorithms to find the minimum path length to scan this area. This problem corresponds to finding the shortest Hamiltonian cycle in a complete graph G = (V,E) of an n nodes. Thus the path planner consists of finding a permutation of the set \{wp_1,wp_2,wp_3,\ldots,wp_N\} that minimize the quantity:

\[
\sum_{i=1}^{N-1} d(wp_i, wp_{i+1}) + d(wp_N, wp_1)
\]

where d(wp_i, wp_j) denotes the distance between waypoint wp_i and waypoint wp_j.

2- On-Line path planning: In this phase the path planner reads information from on-board sensor systems and uses the genetic algorithm to avoid any detected obstacles.

A genetic algorithm for both Off-line and On-Line phases will soon be designed, implemented and tested using MATLAB® and Genetic Algorithm TB and Direct Search TB from the MathWork Inc.

Figure 1: Path between two points avoiding the highest points in a terrain.

This work is supported by a joint Ph.D. grant of the German DAAD and the country of Yemen, starting in October 2008.

Navigation with camera pictures
- Simulation with Virtual Reality -

P. Seibold

Our airship is partly controlled by means of image processing with respect to position, orientation and speed. In order to receive 2D information, a camera is mounted underneath the airship. Every 20ms a picture is taken and compared to the preceding picture. The comparison delivers a measure of the translation and rotation of the two pictures in relation to each other. With this, the new position and orientation can be determined with respect to the preceding position. The height above ground is assumed as given. With a determined starting point, the absolute position is calculated by dead reckoning. The calculation method used is the “Optical Flow”, introduced by Lucas and Kanade [1, 2]. In an ideal case, for every picture dot the disparity in pixel is given. The following pictures show a simulation with the help of a virtual world (VRML) environment [3].

In the left picture the given path is marked by big squares. Small squares depict the positions in relation to the preceding picture, while small circles indicate the result of the dead reckoning. Both pictures on the right contain the flow vectors of 2 consecutive pictures. Each arrow starts at the old pixel position and points to the new pixel position.

The final goal of the work described here is to control the position, orientation and speed of an airship by image processing. Two cameras are mounted on the airship. By comparing the pictures of both cameras, taken at the same time, the distance above ground can be calculated. By comparing two pictures from one camera taken at different times the distance and the rotation of the airship movement can be estimated and with the time difference the speed vector can be calculated.

So far simulations were done in our lab with the use of virtual reality (VRML) [1]. The results were very promising. But the artificial pictures were not close enough to reality, because the two pictures compared were exactly the same in the matching section, the illumination remained constant and there was no variation in height above ground.

With the help of a gantry crane, real photos can be taken with an experimental setup. The dimensions of the table are 2.2m×1.2m×3.1m [X×Y×Z]. The crane covers an area of approx. 2m×3m. The maximum speed is 10m/s.

The position of the crane load (camera) in this experiment has an accuracy of 0.1 mm. The rotation of the camera is ± 170°, with 0,075° deviation. By changing the optical zoom different base altitudes can be simulated.

The crane system is controlled by a host-PC which sends the desired position to a target PC. The position is set by a real time controller in the target PC. The cycle time is 10ms.

When the correct goal position is attained, the target PC sends a message to the host PC. The camera rotates to the desired angular orientation and the picture data are captured. By taking several pictures on a given path, a flight of the airship is simulated. Taking pictures on a parallel path gives the stereo pictures for the elevation calculation.

Processing of the pictures will result in a description of the “flown” path. Processing is done by using methods of the Optical Flow [2].

The communication link between the PRT autonomous airship (blimp, UAV) [1] and ground control station is realized redundantly over three communication channels in different frequency ranges. The intended communication channels consists of a WLAN connection following the IEEE 801.2h standard in the 5 GHz band, a serial connection within the 800 MHz band and a GPRS/UMTS broadband connection in 1.9 to 2.1 GHz band. Apart from the redundancy (connecting security, reliability) this structure offers Internet connection with the advantage to access external maps, GIS data (geographic information systems) and Web services. Furthermore a simple interoperability can be realized to external services of the project partners. An extremely flexibly user interface can be integrated in such a way. Each notebook with WLAN or GPR T/UMTS Internet access or small devices like PDAs or smartphones can be used for ground control. In order to ensure real redundancy, advanced routing and load balancing techniques are used to realize traffic shaping and traffic control (quality of service) over a VPN (virtual private network). This approach allows the usage of the full bundled communication bandwidth. It realizes a safe and stable data link secured over VPN. The mobile phone providers in Germany have reached a nearly complete network coverage today. Even in case UMTS and EDGE coverage is not available GPRS connections with up to 58,6 kBit/s can be used country wide. This bandwidth is sufficient for transmission of highly compressed MPEG4 video streams, sensor and command data. It can be expected that in short time full UMTS coverage with bandwidths of 384 kBit/s up to 7.2 MBit/s will be available. UMTS uses frequency ranges from 1.9 GHz to 2.1 GHz (Germany). The related communication hardware is very inexpensive. Very low power consumption and very low weight are further advantages of this approach. However communication latency is much higher (GPRS up to 2 seconds, UMTS ≤ 1 sec.) than with other proposed channels. Two mobile communication contracts are necessary for the implementation. However appropriate inexpensive flat fees are available. The coverage of this communication approach substantially reduces the risk of a loss of the blimp. The selected components are integrated at present and tested in an embedded PC system. Range and throughput measurements are still to be carried out. A Web-based user interface is currently under development.

Temperature control represents one of the basic tasks in many areas of control applications. At the same time, by its specific dynamics with the fast and slow mode, by its nonlinear character, available sensors, easy construction and maintenance and a simple physical interpretation of running processes, control of scaled laboratory thermal plant models is appropriate also for demonstrating and comparing different methods and tools of identification and control.

The available thermo-optical plant laboratory model (Fig.1) consists of a halogen bulb 12V DC/20W (elements 1-6), of a plastic pipe wall (element 7), of its internal air column (element 8) containing the temperature sensor PT100, and of a fan 12V DC/0.6W (element 9 that can be used for producing disturbances, but also for control). Thermal plant represents one channel of the plant that can be simply used in university laboratories for remote experiments. In total it offers measurement of 8 process variables: controlled temperature, its filtered value, ambient temperature, controlled light intensity, its derivative and filtered value, the fan speed of rotation and current. The temperature and the light intensity control channels are interconnected by 3 manipulated voltage variables influencing the bulb (heat & light source), the light-diode (the light source) and the fan (the system cooling). Besides these, it is possible to adjust two parameters of the light intensity derivator. Within Matlab/Simulink or Scilab/Scicos schemes the plant is represented as a single block and therefore avoiding the need of costly and complicated software packages for real time control. The (supported) external converter cards are necessary just for sampling periods below 50ms.

The plant is used for developing a broader library of tasks to be solved by students and, at the same time, also for demonstrating research results aimed at identification and control of linear and nonlinear systems. One paper presented at the EPE conference [1] was devoted to plant identification using a recursive method of consecutive integrals and by application of the identified model for tuning of constrained pole assignment controller. Experiments proved an excellent control quality that can be shown to be close to the fastest possible monotonic step responses. For the next future it is planned to use the plant for demonstrating possibilities of advanced nonlinear identification and control.

Online robot simulation contest

Ivan Masár

As mobile robots and various robot contests became very popular in the past years, we developed the concept of a novel event for students of our master module „Mechatronics and robotics“ – a virtual robot contest [1]. The main idea was to allow students to participate in a robot contest and to design control strategies for various robot tasks without having a real robot. Instead, they can use a simulation and a virtual model of the mobile robot F.A.A.K., which was designed at our department. Typical objectives of the competition are line following or path finding in a labyrinth.

The virtual robot contest consists of an asynchronous and a synchronous phase and is organized as follows. At the beginning of the contest, the participants get the simulation model of the robot and development tools. The robot is programmed and simulated using a comprehensive integrated environment based on the MATLAB/Simulink software package. These developing tools include simulation models of all robot subsystems (drives, sensors, visual system, etc.) and also a model of its environment. Thereby, complex simulations of the robot interacting with its environment can be performed and visualized by a 3D robot model.

In the asynchronous phase of the contest, the students work alone or in small teams on their solution of the given problem. During a term, they get an introduction from the lecturer and can exchange their experiences. Moreover, they can discuss various problems which arose while programming the robot during online sessions. These sessions take place in regular intervals (every two or three weeks) during this phase. In the final stage, the robot contest is organized as a synchronous event. The students use a VNC-client to watch the simulation of the competing mobile robot and use Teamspeak for voice communication during the contest.

On the contest day, the students get the final map for the particular task and upload their control algorithms. Thereafter, the robots are simulated on the server in Hagen and the participants can watch the simulation. After the first round of the competition, the students get some time to change/adapt their algorithms to achieve better results. Afterwards, the final round decides about the winner.

The online simulation robot contest was organized for the first time in the winter term of 2006. Because of the positive response from the students, this event takes place regularly in both winter and summer term. The main improvement in the future will be the option to program the real mobile robot with the best algorithms after finishing the contest. A video of this event will be available on our web-site and will demonstrate the robot’s performance in a real environment.

Figure 1: „Path following” contest
Figure 2: „Labyrinth crossing” contest

(1) http://prt.fernuni-hagen.de/pro/faak/roboterwettbewerb
Pediaphon presentation at the Learntec 2008 fair

Andreas Bischoff

http://prt.fernuni-hagen.de/~bischoff/

At the Learntec 2008 [3] fair in Karlsruhe the 'Pediaphon' project [5] was presented at the university joint booth. Pediaphon is a web based service which generates audio representations of Wikipedia articles dynamically. The tool is usable on- and off-line, as a web based service to listen to the articles directly in the web browser as well as to download MP3 files for later use on mobile devices like MP3-players and mobile phones.

The mobile phone branch of the service was enhanced by a new touch tone input approach [1]. Like the input of a SMS the numerical keys must be pressed more than once to access the corresponding letter. Numerical keypads are usually already labeled in that way. The chosen letter will be repeated after each input. A voice menu assists the user during input. After successful processing of the search keyword the playback of the requested article starts. During audio playback the users are able to navigate in the phone announcement by pressing predefined keypads. At any time users can stop the playback and redefine their search.

The project was introduced in the 3SAT magazine 'neues' [4] as an example of mobile learning [2].


Augmented sensor data for mobile remote experimentation

Andreas Bischoff
http://prt.fernuni-hagen.de/~bischoff/

To establish mobile learning environments we have adapted Web-based remote laboratories to mobile devices like PDAs and smart phones. Our on-line lab experiment is a remotely controlled Pioneer 3 AT mobile robot [1].

A platform independent approach to realize web-based user interfaces on mobile devices is the use of asynchronous Javascript. With asynchronous Javascript an application behavior like Java applets or interactive Flash movies can be implemented. In combination with the exchange of XML based messages between client and server, these techniques are well known under the term ‘AJAX’. Windows Mobile does not support an AJAX framework directly, but asynchronous HTTP requests are possible in Javascript.

The new asynchronous web client works on each Windows Mobile device without any additional software. Opera Mobile on Symbian OS, the new Google smart phone OS Android [2] and Apple’s iPhone are supported as well, only the video streaming solution have to be adapted for these platforms.

To overcome restrictions dealing with limited screen sizes, sensor data like position information and a moving map have been augmented in real time into the video stream to save limited place (320x240 pixels) for the GUI.


The Wowwee Robosapien RS Media robot is an interesting device for remote experimentation, lab practice, e-learning and teaching 'robotics’. Since the robot was produced as a toy it is available on the market for a low price. The robot is equipped with a camera module, infrared sensors, a microphone and bumpers. The on-board ARM processor runs a customized embedded Linux OS. All robot joints can be controlled by shell scripts or by a J2ME API. The robots behavior can be programmed graphically via a simple Windows based software. The robot can playback prerecorded MP3 files depending on sensor events. The embedded Linux kernel does not support TCP/IP networking and kernel configuration for the device is not available. To access the robots command prompt the ARM processor board serial console is connected to a bluetooth module [1].

We have realized a robot Web interface for PDAs and mobile phones. Due to the lack of TCP/IP support, a Web-based interface to the robot requires an external web server. This web server sends client movement requests via CGI script to the serial console of the robot. The user is able to request remotely from the robots integrated camera to take a photo, and to initiate the upload via zmodem to the web server.
DAAD project „Autonomous airships“

M. Gerke and I. Masár

The DAAD [1] PPP project „Autonomous Airships“ was initiated in 2006 and its main aim was to strengthen the collaboration between FernUniversität in Hagen and Slovak University of Technology in Bratislava, Slovakia, by the joint development of autonomous flying robots. At present, both participating research groups are working on similar mobile systems:

- Control System Engineering Group in Hagen (Prof. Dr.-Ing. Michael Gerke) on an autonomous airship and
- Institute of Control and Industrial Informatics in Bratislava (Prof. Dr. Mikuláš Huba) [2] on an autonomous helicopter. Within this project, several students and researcher exchanges took place between both universities.

During the first year of the project (2007), the concept of an autonomous indoor airship and some of its subsystems have been developed:

- Inertial navigation system, based on acceleration and angular rate MEMS sensors with data processing algorithm based on Kalman filtering;
- Image processing unit for airship navigation using landmarks;
- Remote control for teleoperation of the airship.

The activities of the second year of the project (2008) have been concentrated mostly on identification and visualization of autonomous airships. Presentation of research results achieved during the project and academic activities were given to members of both participating universities. Moreover, information and experiences about eLearning methods in teaching of control and automation have been exchanged with special respect to experiments in mobile and flight robotics.

After finishing the project it can be stated, that the exchange of scientific know-how and cooperation by solving of various problems has rapidly accelerated the development of both types of flying robots (airship and micro-helicopter) and also the relation between both groups has been tightened. Future cooperations and common projects are under consideration.

(1) http://www.daad.de
(2) http://www.urpi.elf.stuba.sk
Analysis of the ATF DINGO 2 with passive and active chassis
Marco Klöckner and Michael Gerke

The development of a simulation model for the full-protection transport vehicle (ATF) DINGO 2 with respect to the analysis of its stationary and non-stationary dynamics during motion and its vertical dynamics as a reaction to steering and lateral runway profiles were subject of this M.Sc. thesis. A specific multi-body model of the vehicle was deduced from all substantial subsystems based on manufacturers data or on-site measurements, thus offering access to modal analysis of the passive SIMPACK model. This model was validated during experiments on the WTD-41 test tracks.

This model was extended through active elements of the AGIL-R wheel suspension systems [2], leading to a coupling of MKS-SIMPACK and MATLAB/Simulink. This provides a first approach to controller implementation and gives insights to the performance of an active suspension system even before a mechatronical prototype exists.

Figure 1: DINGO 2 - Test system

The M.Sc. thesis of Mr. Marco Klöckner was finished as number 10 in the specialisation ‘Mechatronics’ of our M.Sc. programme in Electrical Engineering.

[1] M. Klöckner:
Modellbildung und Analyse des Allschutztransportfahrzeuges DINGO 2 mit passiver und aktiver Fahrwerksauslegung
M.Sc. Thesis 2008, FernUniversität in Hagen (in German)

[2] E. Schäfer, A. Wielenberg:
Realisierung einer aktiven Federung für ein geländegängiges, allradgetriebenes Radfahrzeug der 8-12 Tonnen Klasse (AGIL-R)
Abschlussbereich 2006, Universität Paderborn
Learning environment for behaviour based robot programming

Th. Jourdan, U. Borgolte

In the 80s of the last century, developments were made to enable autonomous systems with some kind of ‘intelligence’, which needs no internal representation of the environment. This was inspired both by biological research on insect behaviour and by new theses on modelling of intelligent behaviour. First promising results have been achieved with small mobile robots. From the historical point of view, behaviour based programming is in contradiction to classical methods of artificial intelligence. Nowadays, both approaches are developed further on under the generic term embodied intelligence.

The master thesis describes basic principles and elements of behaviour based programming and analyses existing solutions. The focus is on Brooks’ subsumption architecture and on Braitenberg vehicles. Based on constructivist didactics, a method is introduced to make students familiar with these concepts. Special emphasis is placed on the subject-specific dimension of behaviour based programming. It is intended that the learner is directly interacting with the robot.

A prototypical learning environment for behaviour based programming is introduced (fig. 1). It is composed of an integrated software development environment, a domain specific programming language, and firmware for the embedded robot control. The very limited hardware resources of the target platform are taken into account. The implementation was done with open source software components and tools.

Main elements of the GUI of the integrated development environment are: 1) Program editor, 2) actors, sensors, diagnostic LEDs, 3) process data, and 4) an interactive tutorial.

The environment has been tested with a small mobile robot, the c’t-Bot. The computing architecture of the robot is based on an ATmega-32 CPU, 32 KByte Flash, 2 KByte RAM, and 1 KByte EEPROM. The sensor instrumentation is very comprehensive for this kind of robot. It comprises two infrared distance sensors, two light sensitive resistors, two wheel encoders, 4 light barriers, and an optical mouse.


Dr.-Ing. Masár, scientist of our research group, has received a prize for his outstanding Dissertation thesis in the field of robotics on the Dies Academicus 2008 event of FernUniversität in Hagen. The topic of his thesis is on 'Construction, Modeling, Control and Path-Planning for a quasi Omnidirectional Mobile Robot'.

The dissertation thesis and the related scientific work is focussed on the construction and development of a new type of omnidirectional robots with high manoeuvrability in restricted environments and led to the real robot F.A.A.K., which participated in several robotic contests. The mobile robot is equipped with Digital Signal Processors for control purpose and an image processing system for obstacle recognition and path following. It possesses 4 steered wheel, two of them are actuated.

In his 'laudatio', Prof. Hoyer (Rector of FernUniversität) stressed the highly demanding scientific character of this Dissertation thesis with respect to its multidisciplinary system approach in the field of 'robotics and control'.

Our research group congratulates Dr.-Ing. Masár for receiving this honorable prize, which is donated by the Sparkasse Hagen.

[I. Masár:
Konstruktion, Modellierung, Regelung und Bahnplanung eines quasi-omnidirektionalen mobilen Roboters
Dissertation Thesis 2007, FernUniversität in Hagen
(in German)