EmQopter
Drone Tech Experts

Digital Version

Flying Robots

Flexible, Intelligent, Reliable

optimized for

Industry, Logistics, Commerce, Teaching and Research

MADE IN GERMANY • HERGESTELLT IN DEUTSCHLAND

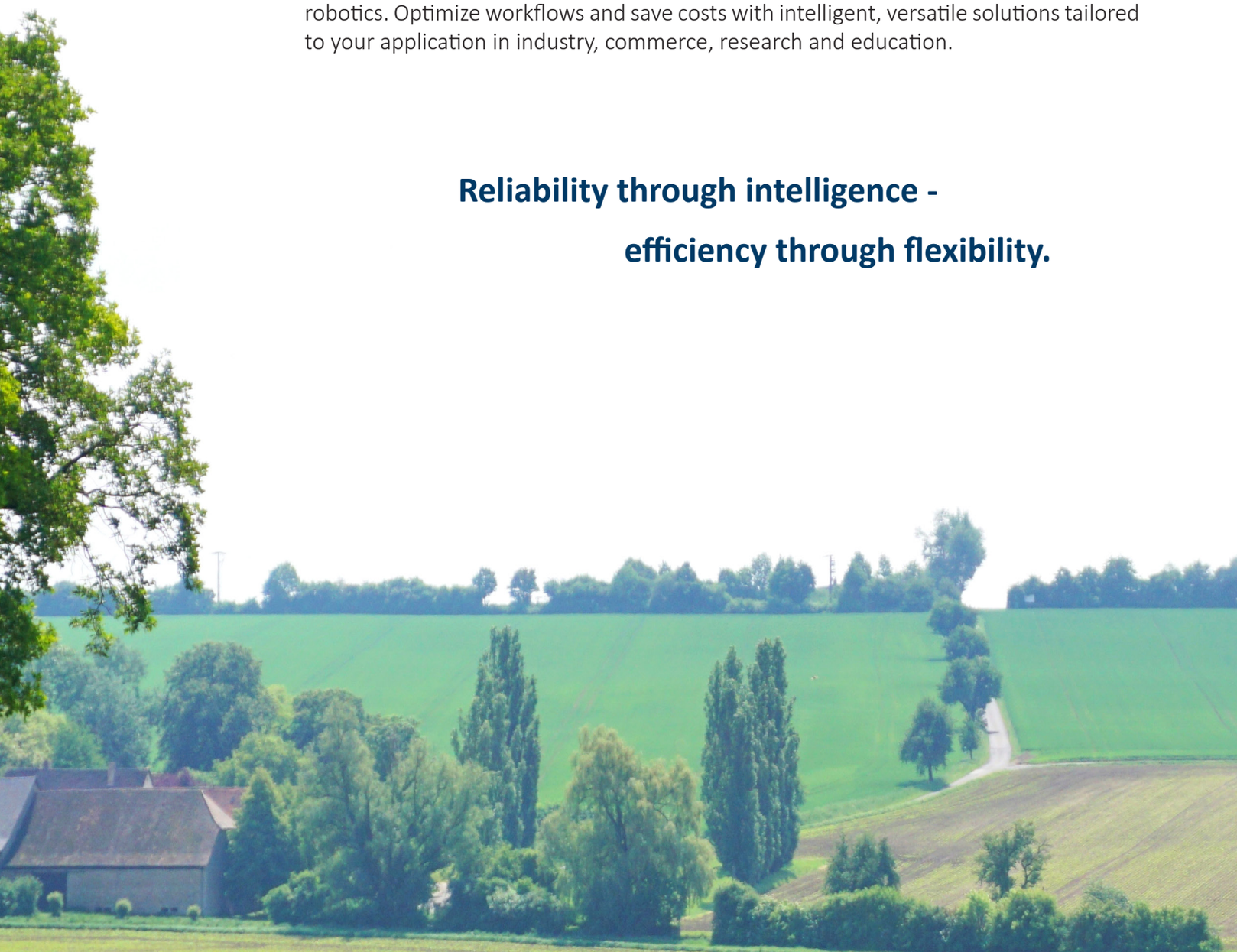
www.emqopter.de

Overview

Emqopter is your partner for unleashing unused potential through cutting-edge aerial robotics. Optimize workflows and save costs with intelligent, versatile solutions tailored to your application in industry, commerce, research and education.

Reliability through intelligence -

efficiency through flexibility.



The first urban fully autonomous Delivery Drone

powered by
Emqopter AI

Fully autonomous transport through the air saves time and money! Thanks to intelligent sensor technology, the entire flight from takeoff to landing takes place autonomously. Instead of being stuck in a traffic jam and producing emissions, the Delivery Drone autonomously flies over the shortest distance by air to its destination.

This saves you money, protects the environment and is also fun!

YOUR ALL-INCLUSIVE PACKAGE FOR MAXIMUM FLEXIBILITY, EFFICIENCY AND SAFETY

The shortage of skilled workers combined with high cost pressure creates major challenges for logistics. Things have to be faster, more digital, fully plannable, more reliable, and more cost-efficient. These are our demands on logistics of tomorrow. To make it as easy as possible for you to get started, we have put together an all-inclusive package:

Permission
We will take care of the approval with the aviation authority for you.

Setup
For initial integration, we will visit you on site and put your delivery line into service.

Training
Your employees will be trained and qualified by us in theory and practice according to the legal requirements.

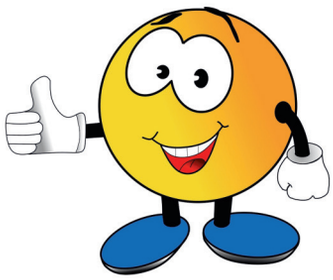
Service
Of course, we will be happy to assist you at any time.

Maintenance
We provide maintenance and repair in accordance with the legal requirements.

YOUR ADVANTAGES

Our fully autonomous Delivery Drone is the optimal solution for flexible and efficient transport of urgent goods and small parts!
As an octocopter with redundant motors, the delivery drone is capable of carrying loads of up to 5kg and transport them autonomously, i.e. without the intervention of a pilot, to their destination. You too can benefit from the advantages offered by this masterpiece of high tech:

- **Cost savings**
- **Maximum flexibility**
- **Emission-free transport**
- **Highest reliability in planning**
- **Pioneering technology**
- **Optimal for transport of small parts**
- **5 % of the maintenance costs of a regular car**
- **85 % of energy savings compared to e-cars**



The system:

Empty weight:	approx. 9 - 15 kg
Max. takeoff weight:	11 - 20 kg
Number of rotors:	6 - 8
Span width:	140 - 180 cm
Transport volume:	ca. 25 x 35 x 35 cm
Max. flight time:	20 - 60 min.
Range:	1 - 20 km
Speed:	20 - 50 km/h

Fully redundant control an electronics

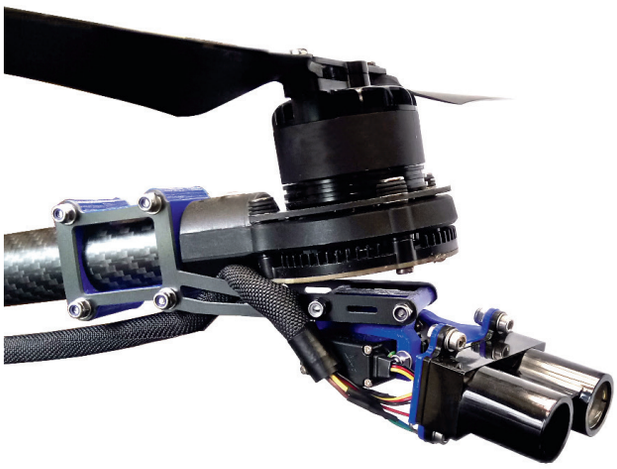
Proven safety concept

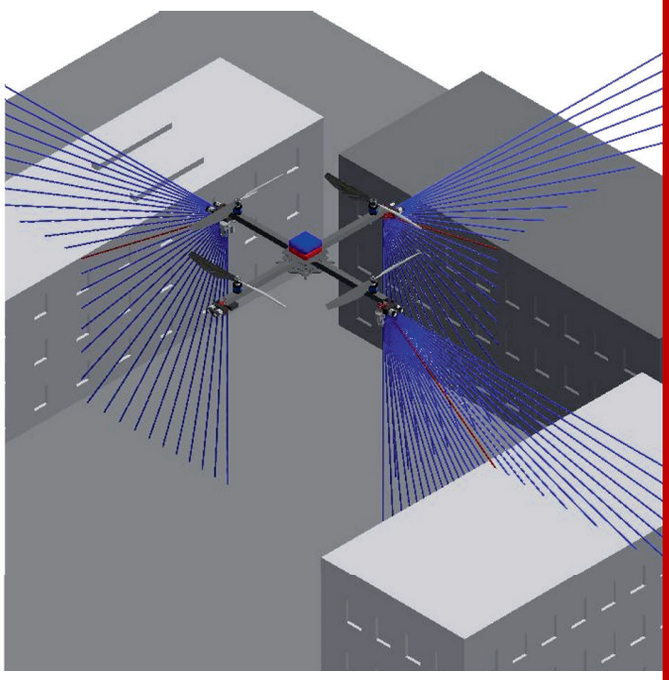
Other specification possible at any time

PATENTED SENSOR TECHNOLOGY FOR EVEN MORE SAFETY AND RELIABILITY

With the patented sensor system, our Delivery Drone finds the suitable landing site even without a pilot! This allows us to achieve a high level of reliability and even in critical situations we can safely complete the mission!

Simultaneously, the sensor technology is used for collision avoidance, which additionally increases the reliability of the system! This enables a fully autonomous flight from take-off to landing and from yard to yard.





The first fully autonomous Delivery Drone - developed by Emqopter - was designed as a contract work for our first customers specifically for the urban transport of small parts, medical supplies and laboratory samples. For the highest possible safety of the autonomous flight operation, the patented sensor system for landing site detection was developed.

The delivery line (Northern Bavaria, 2018)

powered by
Emqopter AI

The Intelligent Drone Port

powered by
Emqopter AI

Automated fully integrated end-to-end transport using the Delivery Drone

The Drone Port enables fully automated process integration of Delivery Drones into our customers‘ logistics chain.

The Drone Port is **modular**, which means that it ultimately doesn‘t matter which manufacturer the drone comes from. Only the intelligent transport box has to be installed on the selected drone and it is ready for use in the system.

Our Drone Port is also very **integration-friendly**, as the system can be easily integrated into the customer‘s technology - automation technology and SAP - allowing it to fit seamlessly into the existing process.

The use of the Drone Port is very **flexible**, as there is no need for a specific type of building. For example, the system can be put into operation on a garage, in a yard or on a roof. Depending on the use case and the conditions on site, the package can either be deposited directly by the drone or the robotic system can be used for further transport to the automation technology (assembly line).

COMPONENTS

The fully automated Drone Port consists of three parts: The box (EMQbox), the robotic system (robot EMQbot) and its interface for automation (EMQint with assembly line).

The Drone Port - EMQport (Components)

EMQbox ™

The intelligent transport box **EMQbox** is installed in a Delivery Drone and communicates with it.

EMQbot ™

The autonomous robot **EMQbot** is used for automatic loading & unloading as well as recharging of the batteries.

EMQint ™

The feeding technology serves as a standard interface **EMQint** with the automation technology of our customers.

Thanks to the consistent interface **EMQint** and the intelligent control software **EMQface**, all processes interact smoothly. In addition, the Drone Port can be expanded with additional modules, such as the drone hangar **Qub** or the loading station **EMQload**.

BENEFITS

- FULLY AUTONOMOUS
- MODULAR
- FLEXIBLE
- INTEGRATION FRIENDLY
- TIME SAVING
- COST SAVING
- EFFICIENT
- FREE OF EMISSIONS

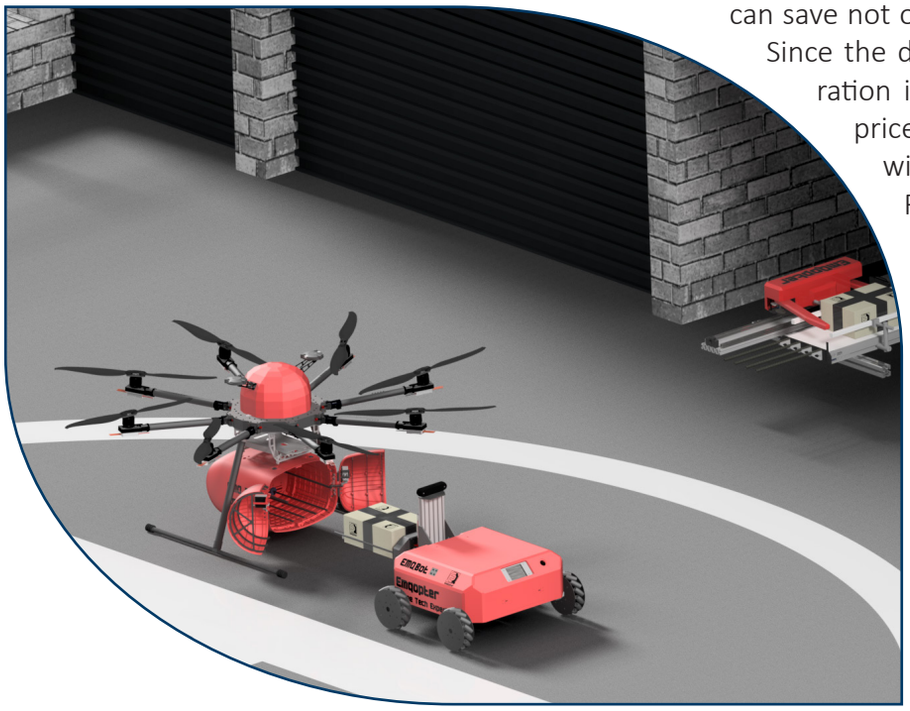
Fully autonomous process integration of Delivery Drones into the logistics chain means that a delivery or package can be transported from one location to another without the need for human intervention.

Since drones fly completely **emission-free**, the operation of a Drone Port ultimately leads to better air quality and has a positive effect on the quality of life, particulary in large cities. Especially in comparison to cars or trucks, it is remarkable how many harmful emissions can be saved by transporting goods through the air.

The already crowded roads on which freight transport takes a lot of time, especially at peak times, can lead to problematic impairments of the supply chains. This is in particular problematic for the transport **time-critical** goods. In airspace, on the other hand, a great deal of untapped potential is still available and just waiting to be unlocked by drones for new transport routes.

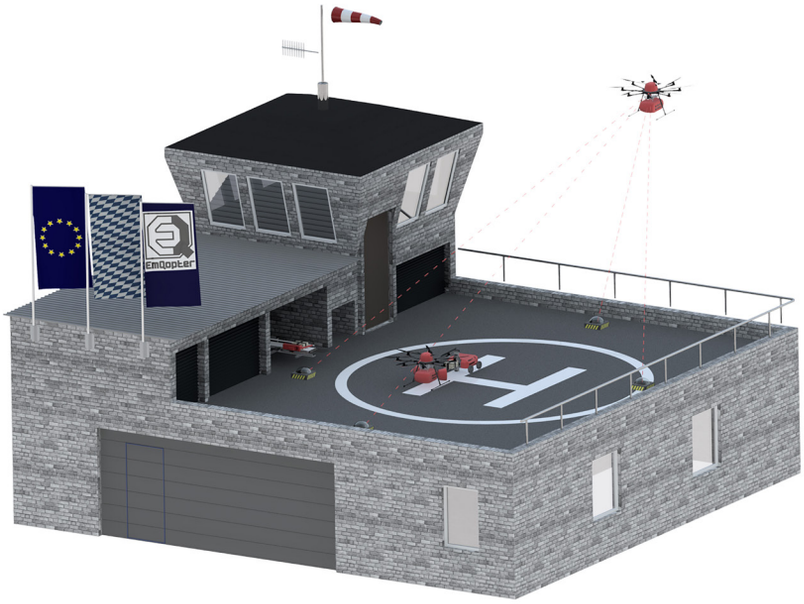
Without the impairments and limitations that ground transport entails, transport via drone can save not only time but also a lot of **costs**: Since the drone is purely electric, its operation is not dependent on rising fuel prices to the same extent as vehicles with internal combustion engines. Furthermore, neither drivers nor manpower are needed to load the goods in autonomous operation.

This also increases operational **efficiency**, as personnel resources can simultaneously be deployed more effectively in other areas of the company.

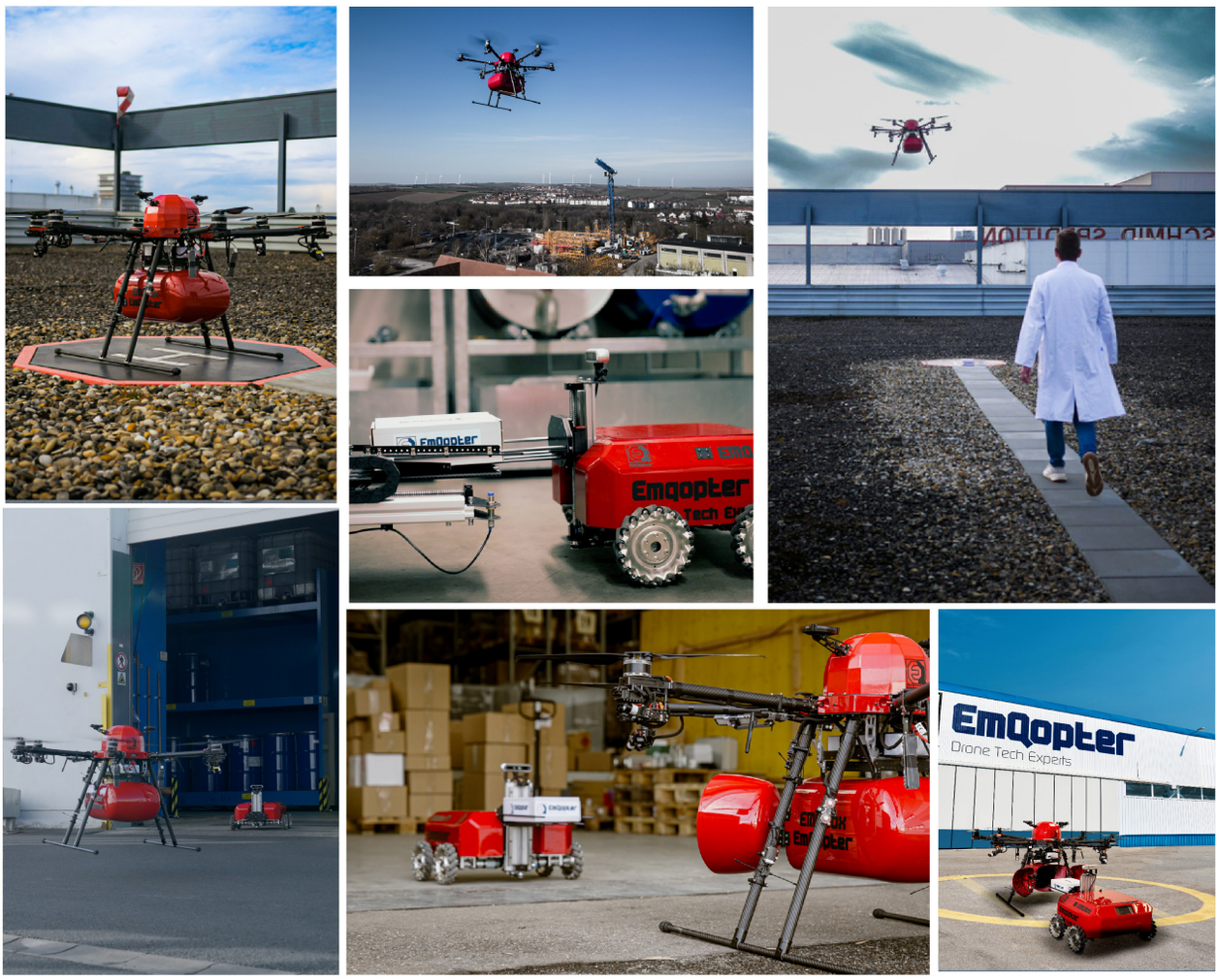


View the
application video here

Scan Me



The Drone Port - EMQport (complete view)



Application examples for the Drone Port

Quadrotor Control System

powered by Emqopter AI

Developed directly in the teaching environment, the Quadrotor Control System - called QCS for short - is a motivating, versatile and above all practical teaching platform for use at colleges, universities and schools.

Motivation and success while studying!

FUTURE ORIENTED TEACHING AT UNIVERSITIES AND SCHOOLS

Technological progress, from computers and smartphones, to embedded systems such as automatic doors and programmable washing machines, to industrial robots and inspection drones, brings us many conveniences and benefits every day. It is hard to imagine our world today without this development. Yet we are only at the beginning. Research and development is currently underway on household robots, autonomous cars and delivery drones. The importance of the associated technologies - the core of which is covered by the STEM subjects of mathematics, computer science, natural science and technology (e.g. mechatronics and control engineering) - is constantly increasing.

The importance of technology is not only rising, but more and more new, additional and more powerful systems are making technology increasingly complex. Inevitably, the need to understand, master and use all of this, as well as to be able to teach and instruct, is growing.

One contribution to this is the Quadrotor Control System (QCS), a teaching and learning system for universities and schools. The programming of quadrocopters or flying robots (drones) is an excellent example of application that motivates students and helps them to understand and master important basics in a fun and playful way. The QCS is both an entry-level aid and a foundation for study, technical and project work, with the aim of developing and deepening knowledge in the field of computer science and technology.

Crash-proof development

The DOF joints fitted to the QCS hold the system in place at the workstation without distorting the dynamics of the system.

Step by step to the solution

Optimal didactic approach due to reconfigurability of the system for the next work steps and tasks.

Start into research

Open interfaces for the integration of your own hardware and software modules according to individual ideas and concepts.

The QCS includes:

- QCS quadrocopter
- DOF joints
- Safety ring
- EMQ3000 development board
- 20 A laboratory power supply
- 8 propellers
- Software framework
- Software libraries
- Documentation
- Teaching and learning contents
- Task examples
- Sample implementations
- Sample solutions
- Locking plates

The DOF principle

The programming and development of a quadrocopter flight control is a complex matter due to the 6 degrees of freedom (DOF) of the free flight. But thanks to the QCS stand's configurable DOF suspension, you don't have to worry about the quadrocopter's crash hazards during development.

Thanks to the DOF principle, you can easily develop your own flight controls and analyze, teach and learn all aspects. It is also possible to safely develop new functions without risking a crash.

The QCS on the DOF joint for the crash-safe development of a quadrocopter flight control system at the workplace.

The QCS stand, specifically designed for quadrocopter programming, is used to fix the system against unwanted lift-off and to mechanically switch individual degrees of freedom. This allows the user to independently edit the individual controllers for the system's various axes of motion.

The configuration of the DOF suspension's degrees of freedom is realized by a simple and fast locking system with three locking plates, so that no conversion breaks delay the development.

In a few seconds, the QCS can be fixed at the workstation and thus operated in a controlled manner, or, as soon as desired, flown freely as QCS-F.

With the QCS, what has been learned can be tested directly at the workplace

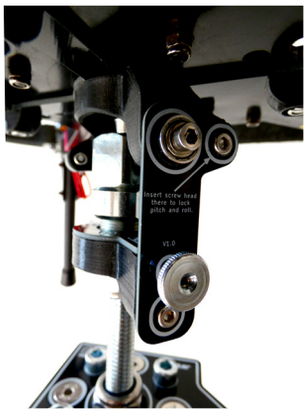
To achieve stable flight attitude control of the quadrocopter in three-dimensional space, three controllers are required. To program the QCS flight controls, you only need the DOF stand and its three locking plates, which allow you to program and configure all controllers independently.

Scan Me

Find the product video here

The 1- and 2-DOF configuration

With the various locking options, you can get started with QCS programming. The roll, pitch, and yaw axes are enabled separately by simply reconnecting them. This allows the position controllers for these axes to be programmed independently of each other. In the second step, the roll and yaw or pitch and yaw axes are enabled and the overlaid controller behavior can be examined and optimized.



By fixing the pitch and roll axis it is possible for you to seperately observe the control of the yaw axis

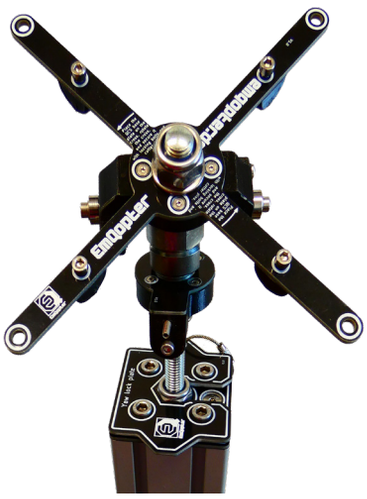
The yaw axis of the QCS can be locked with a further fixation, so that the pitch or roll control can be specifically parameterized.

The locking plates serve the fixation of the axis

The 3-DOF configuration

When the QCS is controlling stably around the roll and yaw axes, the locking plates can be removed in a few simple steps to view the control around all three axes of space.

In 3-DOF configuration, the stand is designed to be very close to free flight in terms of its characteristics. As a result, a quadrocopter that regulates well on the stand in 3-DOF configuration is ready for flight!



A practical connector system is used to mount the QCS onto the DOF joints and it is firmly attached with knurled screws

USE AT SCHOOL

The direct link to practical experience and the work on a highly relevant topic motivates students from vocational schools and high schools to work out solutions on their own.
Learning is faster and easier when it's fun and hands-on. The subject of computer science and quadrocopter programming is covered comprehensively in eight study sections. Each section contains tasks, help, theory, as well as software as a cloze and ready-made solutions. As a teacher, you will receive the background knowledge in a compact introductory course to immediately start teaching with the QCS!

Requirements:

The QCS curriculum assumes a basic knowledge of programming.
One year of computer science instruction is recommended.
In addition, a maximum of one half-year C-fundamentals programming course is required.

Teaching materials:

For each of the eight study sections:

- Theory as booklet or set of slides
- Tasks
- Software framework as a cloze
- Finished programs as solution
- Documentation on hard- and software

Procedure and time frame:

Depending on the in-depth study, the time required ranges from a few teaching units to a half-year. The tasks can be extended or reduced independently of each other in order to focus on specific aspects. It is recommended to cover the basics of programming in C in the first semester and to start with the QCS teaching concept in the 2nd semester.

Target group:

The QCS teaching concept is aimed at students in the 12th year of high school or the 2nd year of a vocational school.
It is optimized for the following subjects:

- Computer science
- Mechatronics
- Robotics
- Control engineering
- Technology

Eight study sections:

- Introduction to information technology and embedded systems
- Information processing (part 1) and representation
- Communication: sending, receiving, processing of information (data)
- Information retrieval and sensor technology
- Information processing (part 2) and filters
- Model building using the QCS as an example
- Control, regulation and parameterization
- Automation

USE IN TEACHING AND RESEARCH

The QCS is a simple and versatile platform for the introduction to embedded programming at universities and colleges. As a teaching tool, the QCS is optimized for use in courses and laboratory exercises. The software is available as an open-source project, allowing students to develop and integrate their own research projects beyond the content of the QCS teaching concept. For student research projects, modern and novel approaches can be implemented directly with the QCS.

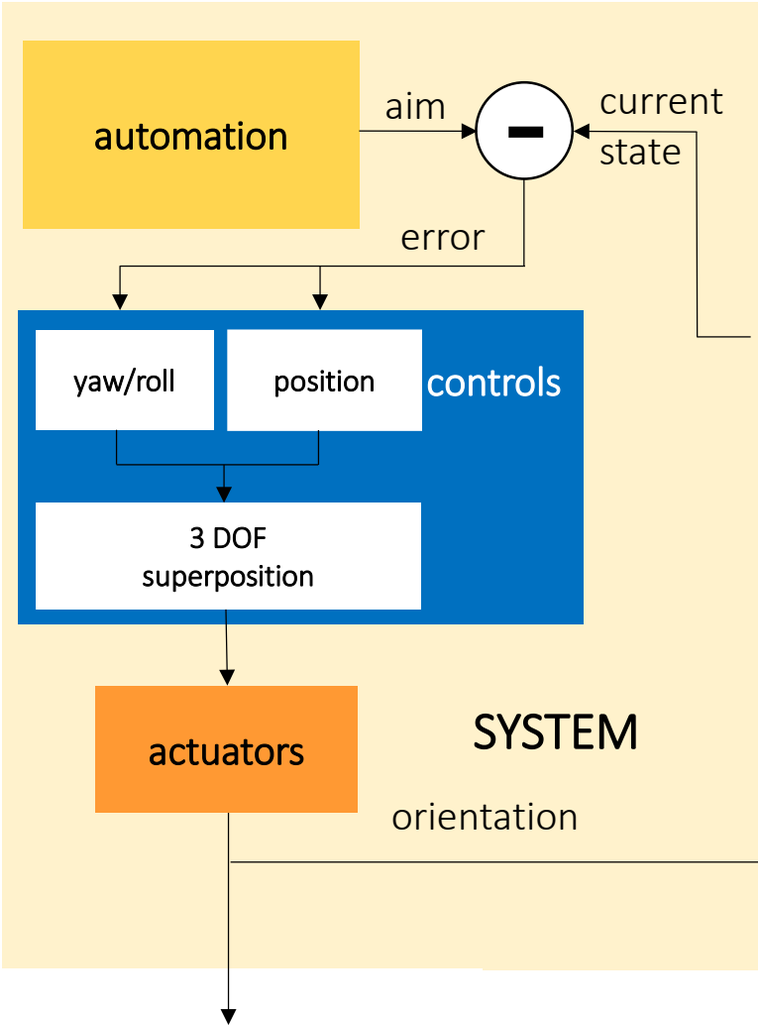
Sample module description of the course:

Module description	Quadrocopter programming
Duration	12 weeks
Frequency of the offer	Once a year
Teaching language	German / English
Requirements	Basic knowledge of C-programming
ECTS - Credits	5
Total workload & composition	150 h (30 attendance, 120 self-study)
Teaching format	Weekly 2h presence exercises with independent preparation and follow-up
Exam services	Testate
Learning outcomes	The participants will be able to implement a flight control system for a quadrocopter. (sensor technology, data processing, filtering, control)
Contents	• Communication: USART, telemetry and telecommanding • Sensor technology and signal processing (Kalman filter, complementary filter, quaternions) • Quadrocopter control (attitude, yaw, 3DOF) • Automation of control commands
Teaching & learning methods	Teaching of the theoretical and technical basics in frontal teaching and demonstrations, problem-oriented tasks for independent work on the Quadrotor Control Quadrotor Control System and PC
Literature	• Faszination Quadrokopter, Büchi, 2010 • Drohnen: seit 1990, Laumanns, 2012 • Regelungstechnik 1, Lunze, 2014 • An introduction to the Kalman Filter, Welch & Bishop, 2006 • Autonome Quadrokopter zur Innenraumerkundung, Gageik, 2015

THE TOPIC BLOCKS

With the QCS you can work through, teach and study the complete programming and handling of information from the first reading of the sensors (information acquisition), through data processing (information processing) to control and automation (model building). For this purpose we have prepared complete teaching materials, which we provide you with in the form of slide sets and a booklet.

In our Youtube video series **„Drone Tech Academy“** all contents are explained! **Don‘t forget to turn on english subtitles!**



12.
Process automation, arguably the most important use case for robotics, is addressed in the final exercise.

11.
Finally, the different controllers are to be superposed to achieve a common and simultaneous control of all three axes in space. In this section, the effects and boundary conditions of superposition and multivariable control are discussed.

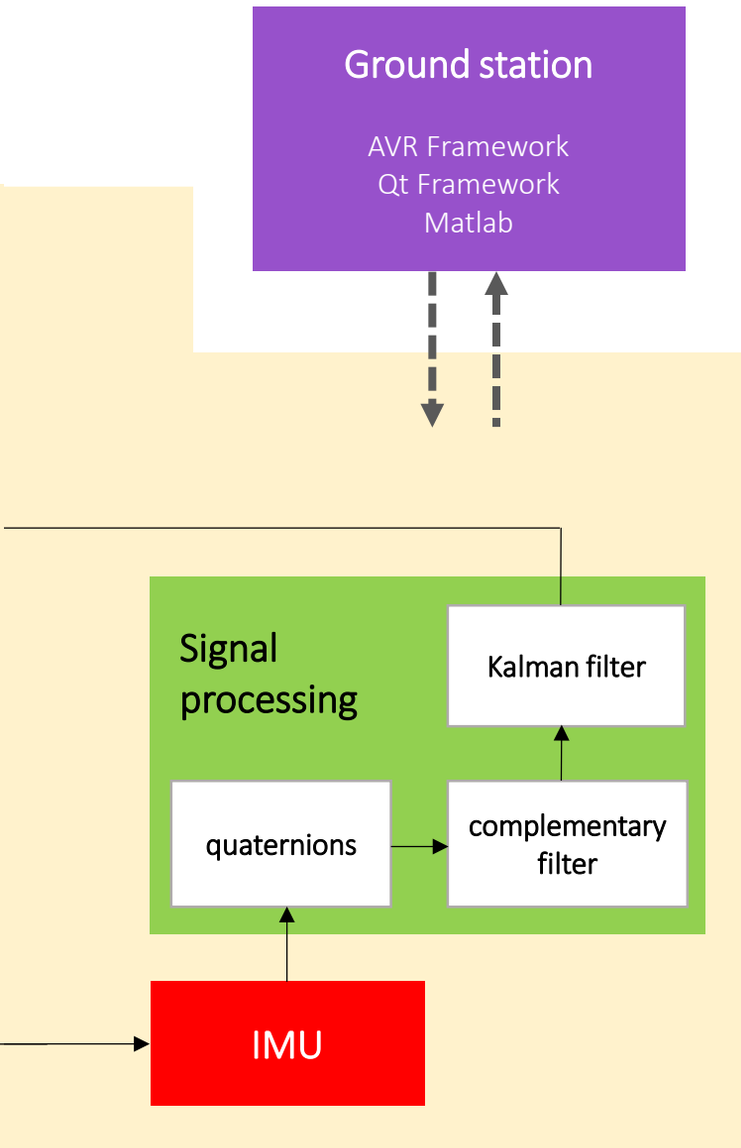
10.
With the addition of a communication interface between **MATLAB** and the QCS, the control of the system via MATLAB is addressed in addition to a deepening of the topics „telemetry“ and „telecommanding“. This way, the implementation and parameterization of custom position controllers can be evaluated with real-time plots as well as made accessible on the running system.

9.
Communication and debugging are important tools for programming embedded systems. All transfers of data between the QCS and the ground station can be designed as you wish. This section provides an introduction to this.

8.
Telecommands are used to transmit commands. This exercise deals with the opposite side of the telemetry or control of the QCS.

1.
The QCS is controlled by an AVR 32bit microcontroller which is programmed in C. In an introductory section the **AVR development framework** and the control of a display are discussed.

Scan the codes for episodes 1 & 2 of the **Drone Tech Academy**
Topic: **Hello Copter**



7.
Telemetry is the transmission of system information to the ground station. For this purpose, a graphical ground station software and a communication protocol are covered.

More episodes coming soon!

2.
For attitude control of a quadrocopter several controllers have to be implemented. The function of a PID controller is explained in two sections as well as the independent control of the roll- pitch- and yaw axis of a quadrocopter.

Scan this code for episode 3 of the **Drone Tech Academy**
Topic: **Position control**

3.
An IMU, a so-called inertial measurement unit, is required for the control of the QCS. With its help, the current orientation can be determined in 3D. In this section, the basics, the control and the readout of the IMU are discussed.

Here you can find episodes 4 & 5 of the **Drone Tech Academy**
Topic: **Position Sensor Technology 1 & 2**

4.
The proper processing of inertial sensor data for the determination of orientation is crucial for its subsequent use in attitude control. Quaternions are the tool of choice for this purpose today. The exercise provides a valuable introduction to the number system of quaternions and their practical uses.

5.
To ensure drift-free orientation determination, an accelerometer and a gyroscope are required. Both sensors have their intrinsic weaknesses, but complementary data fusion can be used to overcome them. The complementary filter discussed in this exercise is a simple but effective tool to achieve this.

6.
The Kalman filter is the most common method for data fusion. It is used in robots, cars, airplanes and spaceships. In this exercise, a Kalman filter for the QCS is explained, discussed and implemented using a simple example.

Find out more about the episodes 6 & 7 of the **Drone Tech Academy** here - Topic: **Kalman filter**

THE BASIC COMPONENTS

The QCS in its basic configuration contains everything you need for a safe and easy start into quadrocopter programming! Thanks to extensive hardware and software, the complete package provides you with everything you need to get started right away!

The QCS is mounted on the included, stable stand and can be used as a portable unit. For your safety, the QCS is equipped with a 360° protection ring by default.

In addition, the kit includes the universal EMQ3000 32bit development board, a powerful lab power supply, the educational content consisting of tasks and solutions as well as spare propellers, documentation and the complete EMQ software framework.

QCS Complete Package Starter

Includes everything you need to get you started in programming!

- QCS Quadrocopter with safety ring
- DOF joints and stand
- Locking plate
- EMQ3000 development board with 32bit AVR, 60 MHz, 512 Kb flash
- EMQ software framework
- Educational content with tasks & solutions
- 20 A laboratory power supply
- Documentation
- Spare propeller set (10“)

The QCS Complete Package Flight contains everything you need to get the QCS up and flying. This includes battery, remote control and receiver as well as an independent onboard microcontroller. The battery mount attaches to the quadrocopter just as easily as the DOF joints in a few simple steps.

The onboard microcontroller is identical. This allows the same software developed on the ground to be used for flight.

If you order our teaching system as a complete flight package, we already integrate the flight module during production.

QCS Complete Package Flight

With the flight module, the QCS is ready for take-off! It includes:

- Complete starter package
- 4S 7000 mAh LiPo battery
- Battery holder
- Remote control and receiver unit
- Landing gear
- Bluetooth telemetry/telecommand module

With a maximum thrust of 4 x approx. 1.8 kg and its 12 inch carbon propellers, the QCS Complete Package Premium is definitely the most powerful system in its class.

This means that it can carry a payload of up to 500 g.

The system is perfectly suited to embed several add-ons on it at the same time. For example, position sensors such as GPS or optical flow can be easily combined with an i7 board and object detection as well as obstacle detection.

Just contact us to learn more about your possibilities with our teaching systems.

QCS Complete Package Premium

For maximum payload requirements!
Included are:

- Complete Flight Package
- Frame Upgrade
- Motor Upgrade Power X
- Propeller Upgrade Power X

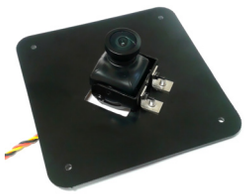
ADD-ONS

A large number of add-ons are available for QCS and QCS-F, which make working with the system even more versatile. For an optimized start, you will receive corresponding driver software for the integration into the QCS as well as sample implementations for each module.

POSITION CONTROL

GPS Module
Positioning for outdoor missions

Optical Flow Basic
Simple 2D acquisition of the QCS-F movement

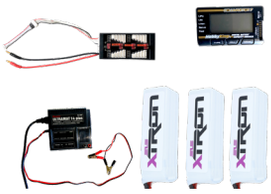


Optical Flow Pro
Robust 4D acquisition of the movement of the QCS-F[1]

CONTROL

Additional RC
Second remote control for simultaneous control

PERFORMANCE AND SAFETY



QCS Power Upgrade
Parallel charger, three additional batteries, safety box and battery tester

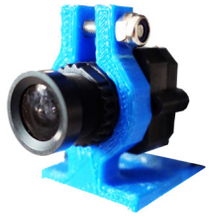
Flight Mode Plus
Pixhawk flight control, EMQ fallback board, EMQ control software

Modular Finger Safe Top
Increased protection against grip into the propellers

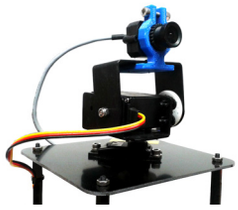
i7 CPU Board
Strong computing power and storage capacity

[1] i7 Board required

OBJECT RECOGNITION

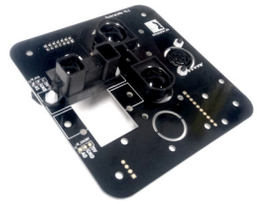


Object Recognition Basic
Frontal camera for object detection[1]



Object Recognition Pro
Pivoting camera for object detection[1]

HEIGHT SENSOR TECHNOLOGY



Height Sensors
Baro, IR and US sensor technology for height determination

Height Sensors Plus
Laser, Baro and US sensor technology for height determination

VIDEO TRANSMISSION

Video Link Basic
Frontal camera with analog video transmission

Video Link Plus
Video Link basic with pivoting camera

Video Link Pro
Pivoting camera with digital video transmission

With the QCS Add-Ons you get everything you need to develop a fully autonomous drone, that can control its flight altitude and avoid collisions autonomously.

[1] i7 board required

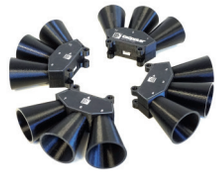
OBSTACLE DETECTION

INFRARED AND ULTRASOUND

Obstacle Detection US
Sensor module with
3 ultrasound sensors

Obstacle Detection IRL
Sensor module with
8 infrared sensors up to 5m

Obstacle Detection IRM
Sensor module with
8 infrared sensors up to
1.5m



Obstacle Detection US12
4-sensor-module with
3 ultrasound sensors

LIDAR TECHNOLOGY

Obstacle Detection LA8
Sensor module with
8 laser sensors

Obstacle Detection LA2
Sensor module with
2 laser sensors

COMMUNICATION

WiFi
Communication module for
data exchange via WiFi

Mobile Radio
Communication module for
data exchange via mobile
radio (4G & 5G)

3D SENSOR TECHNOLOGY

Obstacle Detection RS
3D ToF Intel® RealSense™
obstacle detection

Obstacle Detection PMD
3D ToF PMD
obstacle detection

Obstacle Setection SV
Stereotypical
obstacle detection

All modules with driver and example implementation

COMPLEMETARY SENSOR TECHNOLOGY

Obstacle Detection US-IRM
8 infrared (5m) and
12 ultrasound sensors

Obstacle Detection US-IRL
8 infrared (1.5m) and
12 ultrasound sensors

Obstacle Detection US-LA
8 point lasers and
12 ultrasound sensors

[1] i7 board required

EXPERIENCE WITH THE QCS

The Quadrotor Control System has been used at universities and schools for seven years. The teaching system has proven to be very popular among students and teachers from the very beginning.

Prof. Dr. Fischer explains the Quadrotor Control System to the Brandenburg Prime Minister Dietmar Woidke at the occasion of the Prime Minister's visit to the CeBIT 2016 in Hanover:

„ I have never seen such a highly motivated and long lasting concentration, as well as meticulous solution finding at the workplace"

Prof. Dr. Arndt Balzer from the University of Applied Sciences Würzburg-Schweinfurt is convinced of the QCS:

„We have been using the QCS for several years in teaching (computer science) and are always pleased with how motivated the students are with the varied topics and consistently practice-relevant tasks."

Prof. Dr. Sergio Montenegro and his students at the Chair of Aerospace Computer Science at the University of Wuerzburg, where the Quadrotor Control has been successfully used in teaching for over 6 years, are enthusiastic:

„Just great!"

Prof. Mohiedine Jelali, Control Engineering and Mechatronics, TH Cologne:

"Very good teaching system QCS, very competent partners! Cooperation with EmQopter was good and successful at any time. Management and staff are very attentive and friendly, very strong customer orientation."

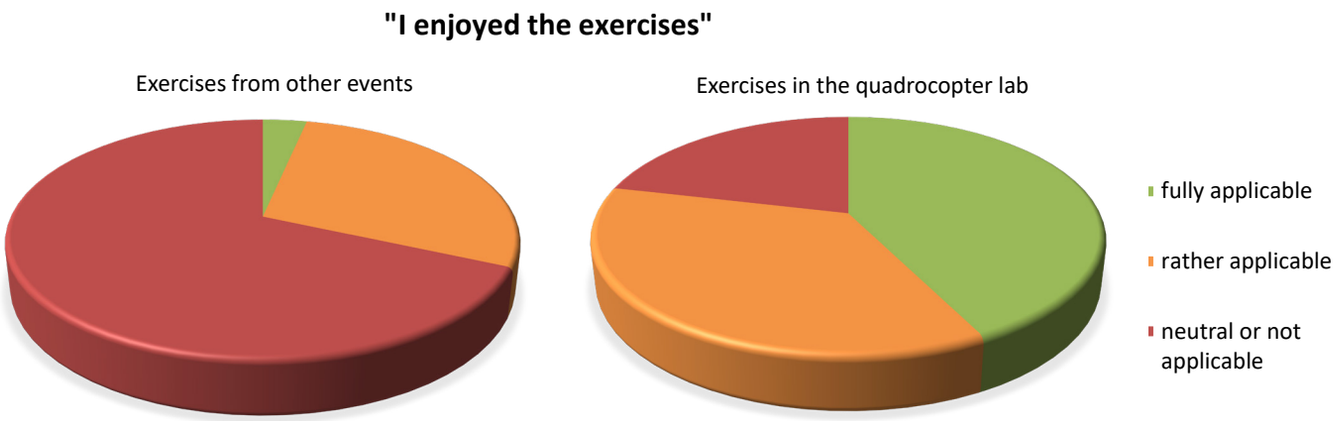
Participants of the Summerschool „Aerospace Information Technology“ 2015 in Würzburg:

„I am in my 1st year master studies and this was the best exercise I ever had!“

„Quadrotor exercises - VERY COOL!“

„I really liked the Quadrotor Lab and enjoyed to work with the system!“

The effect of using the QCS- teaching concept on students was recorded in comparison to other courses. Here are some results
(published at the SPIE- Conference in San Francisco 2015):



QCS DEVELOPMENT PLATFORMS

Use the world's most reliable drone platform for your software or hardware development and present your research results in an appealing way! Thanks to upward and downward compatibility, projects started on the QCS teaching system can now be directly continued and tested on the industrial-grade **carrier system** of your choice. With the help of the extensive documentation, the open programming platform and more than 50 plug-n-play modules, you have almost **infinite possibilities** to develop the system according to your ideas. The innovative **fail-safe system** ensures maximum reliability and helps you avoid unnecessary crashes and damage during the development phase. Depending on the use case, you can choose between **five options** to tailor your system precisely to your application.

DEVELOPMENT PLATFORM *Qlog*

FOR APPLICATION-ORIENTED RESEARCH

Features

- Application oriented development
- Robust system
- High flight times
- Good aerodynamics
- Small, light and easy to handle
- Low operational risk
- Easy approval

Specifications

- Span width: approx. 73 cm
- Take-off weight: approx. 4 kg
- Payload: approx. 200 g
- Max. speed: approx. 20 km/h
- Max. flight time: approx. 10 - 20 min
- Max. range: approx. 1 - 3 km

DEVELOPMENT PLATFORM *Qmed*

FOR RESEARCH IN THE FIELD OF ARTIFICIAL INTELLIGENCE

Features

- Application oriented development
- Robust system
- High flight times
- Good aerodynamics
- Small, light and easy to handle
- Low operational risk
- Easy approval
- 3D camera sensor included
- GPU/ CPU for extensive data processing
- AI applications

Specifications

- Span width: approx. 73 cm
- Take-off weight: approx. 4 kg
- Payload: approx. 100 g
- Max. speed: approx. 20 km/h
- Max. flight time: approx. 10 - 20 min
- Max. range: approx. 1 - 2 km

DEVELOPMENT PLATFORM Q6000

FOR APPLICATION-ORIENTED RESEARCH WITH MEDIUM PAYLOAD REQUIREMENTS AND HIGH RELIABILITY

Delivery includes

Type: Hexacopter

- Frame with foldable arms
- Motors
- ESCs
- Propellers
- Fairing and hood
- Power distribution board
- Dual GPS/GNSS
- Flight control Pixhawk
- EMQ Control with fallback board

Specifications

- Span width: approx. 182 cm
- Payload: approx. 5 kg
- Max. speed: approx. 30 km/h
- Max. flight time: approx. 15 - 45 min
- Max. range: approx. 5 - 10 km

The Q6000 is a premium X6 qopter. It has six redundant actuators (motors, propeller and ESC). This means that up to two actuators can fail. The Q6000 is available as a professional industrial carrier system, e.g. in the Delivery Drone, or as a development platform for research and development. Only high-quality components are installed, including durable, waterproof, dustproof premium motors with corrosion protection, anti-overload and best cooling properties. Depending on the configuration, the payload of the system is 5 to 10 kg with a maximum flight time of 30 to 60 minutes.

Q6000

Delivery Drone

Inspection & surveillance

Quanipulator

Watch the application video

Scan Me

DEVELOPMENT PLATFORM Q8000

FOR APPLICATION-ORIENTED
RESEARCH WITH MEDIUM PAYLOAD REQUREMENTS
AND VERY HIGH RELIABILITY

The Q8000 is a premium X8 qopter. It is available as a professional industrial carrier system, e.g. as a Delivery Drone or as a development platform for research and development. Only high-quality components are installed, including durable, waterproof, dustproof premium motors. Thanks to the eight redundant actuators, the system has a very high level of fail-safety and is particularly suitable for missions with very high safety requirements. Depending on the configuration, the payload of the system is 2-3 kg with a maximum flight time of 20 to 25 minutes.

Delivery includes

Type: Octocopter

- Frame with foldable arms
- Motors
- ESCs
- Propellers
- Fairing and hood
- Power distribution board
- Dual GPS/GNSS
- Flight control Pixhawk
- EMQ Control with fallback board

Specifications

- Span width: approx. 155 cm
- Payload: approx. uo to 2 kg
- Max. speed: approx. 30 km/h
- Max. flight time: approx. 20 - 25 min
- Max. range: approx. 5 - 10 km

DEVELOPMENT PLATFORM Q6500

FOR APPLICATION-ORIENTED RESEARCH WITH HIGH PAYLOAD REQUREMENTS AND HIGH RELIABILITY

Delivery includes

Type: Hexacopter

- Frame with screwable arms
- Motors
- ESCs
- Propellers
- Fairing and hood
- Power distribution board
- Dual GPS/GNSS
- Flight control Pixhawk
- EMQ Control with fallback board

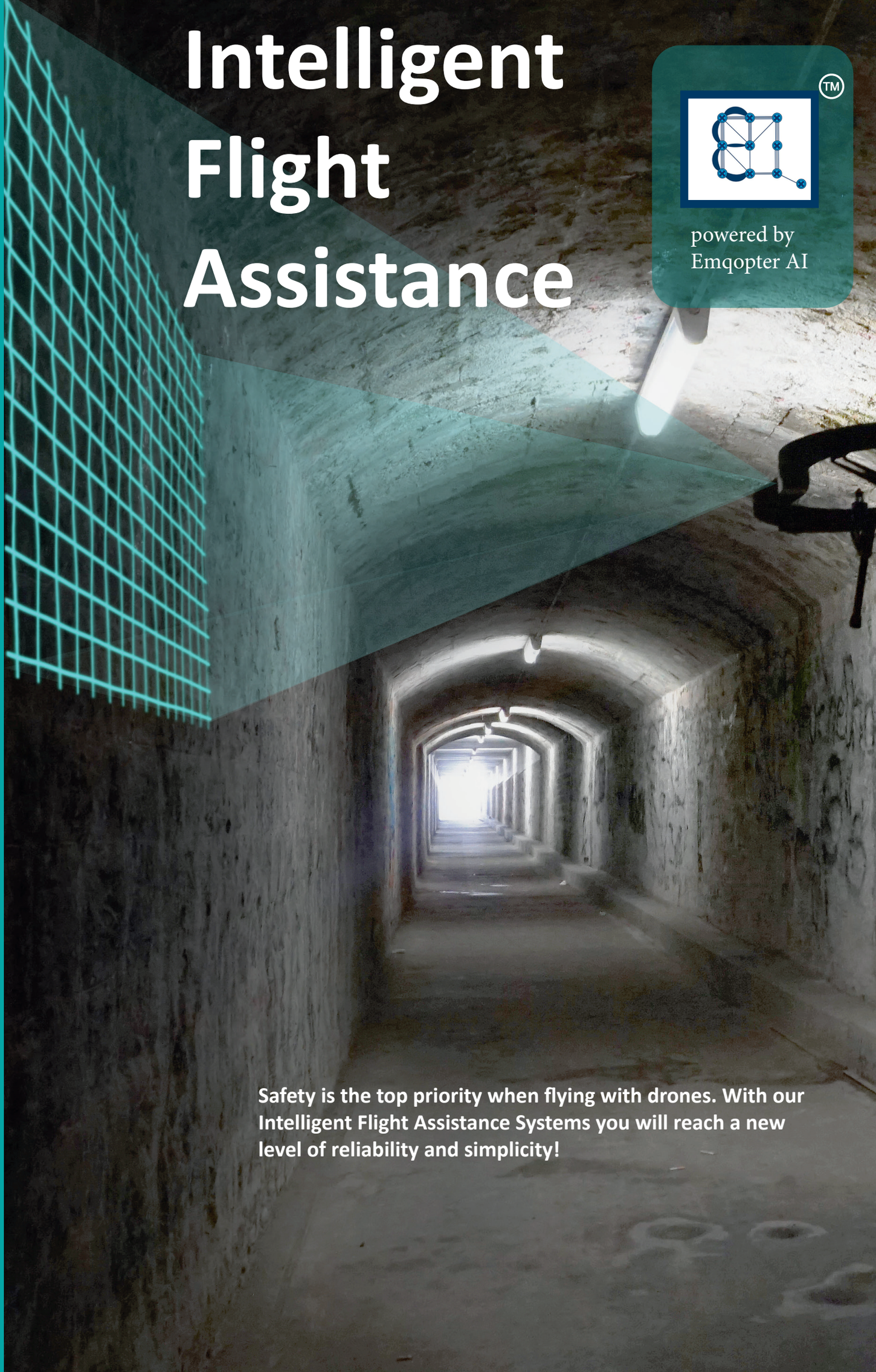
Specifications

- Span width: approx. 236 cm
- Payload: approx. 5 - 10 kg
- Max. speed: approx. 50 km/h
- Max. flight time: approx. 30 - 60 min
- Max. range: approx. 5 - 30 km

The Q6500 is the largest carrier system made by Emqopter. With a payload of up to 10 kg, the hexacopter meets even higher payload requirements. With a flight time of up to 60 minutes, the system is the best available on the market for drones with a maximum take-off weight of less than 25 kg (MTOW < 25 kg). As usual, you can get the Q6500 as an open and freely programmable flyable system with the EMQ Control development platform and Pixhawk flight control or in an all-inclusive package as a Delivery Drone.

Intelligent Flight Assistance

powered by
Emqopter AI



Safety is the top priority when flying with drones. With our Intelligent Flight Assistance Systems you will reach a new level of reliability and simplicity!

SAFETY THROUGH INTELLIGENCE

Intelligent Flight Assistance Systems detect obstacles in the environment, calculate control values in order to avoid collisions and independently regulate the distance to detected objects.

The flexibility of multicopters makes them efficient tools for versatile applications such as inspection, maintenance, photogrammetry and observation. They serve as a platform for high-quality sensors and cameras. Despite the very good maneuverability, it takes experienced pilots to approach the copter to the position for the best shots. However, crash hazards in narrow or blind spots discourage even them from ideally placing the expensive system. Emqopter's goal is to use smart sensors and autonomous features to help pilots do their job and master even the most difficult flights.

Our result of intensive research and development in the field of autonomous drones is a wide range of sensor modules for use on multicopter systems that are optimally adapted to each application. With our many years of experience, we are now able to deliver the perfect system for your individual requirements. At Emqopter, we offer Intelligent Flight Assistance features to perfect the work of flying in challenging environments. Contact us and let us tailor your use case for optimization!

INTELLIGENT FLIGHT ASSISTANCE SYSTEMS IN APPLICATION

For safety reasons, many flights cannot be performed without assistance, even by experienced pilots. However, with Intelligent Flight Assistance Systems, you can master even challenging tasks reliably and easily!

Multicopter systems depend on continuous, reliable control of the flight attitude. This task is performed as standard by the copter's flight control system, which automatically detects the flight attitude via sensors and calculates actuating values to bring the system into the desired alignment. The attitude control also ensures that external disturbances such as wind and large parts are compensated or reduced and the copter is held in place. With increasing wind strength, this attitude control reaches its limits, so that the system quickly drifts a few meters from the target position due to gusts of wind, which can have fatal consequences for your system and the environment.

For inspections performed using close-up images, the risk of collision due to external influences such as wind is a highly critical problem!

Emqopter's Collision Avoidance Systems continuously scan the environment for obstacles in real time and actively interact with the copter's flight controls to prevent collisions. This way, crashes and damage can be avoided.

A reliable Collision Avoidance System is essential to ensure safe flight for inspection and maintenance purposes.

Only by analyzing the flight environment for obstacles during the mission in real time it is possible to fly around objects within the flight path of the copter.

Only intelligent sensors enable autonomous and safe operation.

YOUR BENEFITS AT A GLANCE

Reliability
Intelligent Flight Assistance Systems help you master critical situations and complete your flight missions crash-free.

Time efficiency
With active collision avoidance, you will no longer waste time maneuvering safely to get the best shots.

Cost reduction
Reduce your costs by minimizing repair and maintenance efforts and increasing time efficiency.

Optimal results
Thanks to the Intelligent Flight Assistance Systems, you can concentrate fully on your inspection and maintenance tasks.

Automation
Use the possibilities of autonomously operating flying robot technology and optimize your processes in trade and industry.

Solving complex challenges
With intelligent sensor technology and assistance functions, you can master even the missions that seem too risky today.

The optimal sensor solution for every application!

In order for you to take advantage of these benefits most effectively, it is essential to use the ideal sensor technology that reliably detects the typical obstacles in your application. Each sensor technology has intrinsic advantages and disadvantages, which means that for different applications different solutions are optimal. To give you an overview of the various technologies we work with, we have assembled the portfolio of our sensor modules for multicopters on the following pages. We will be happy to provide you with advice on your specific case.

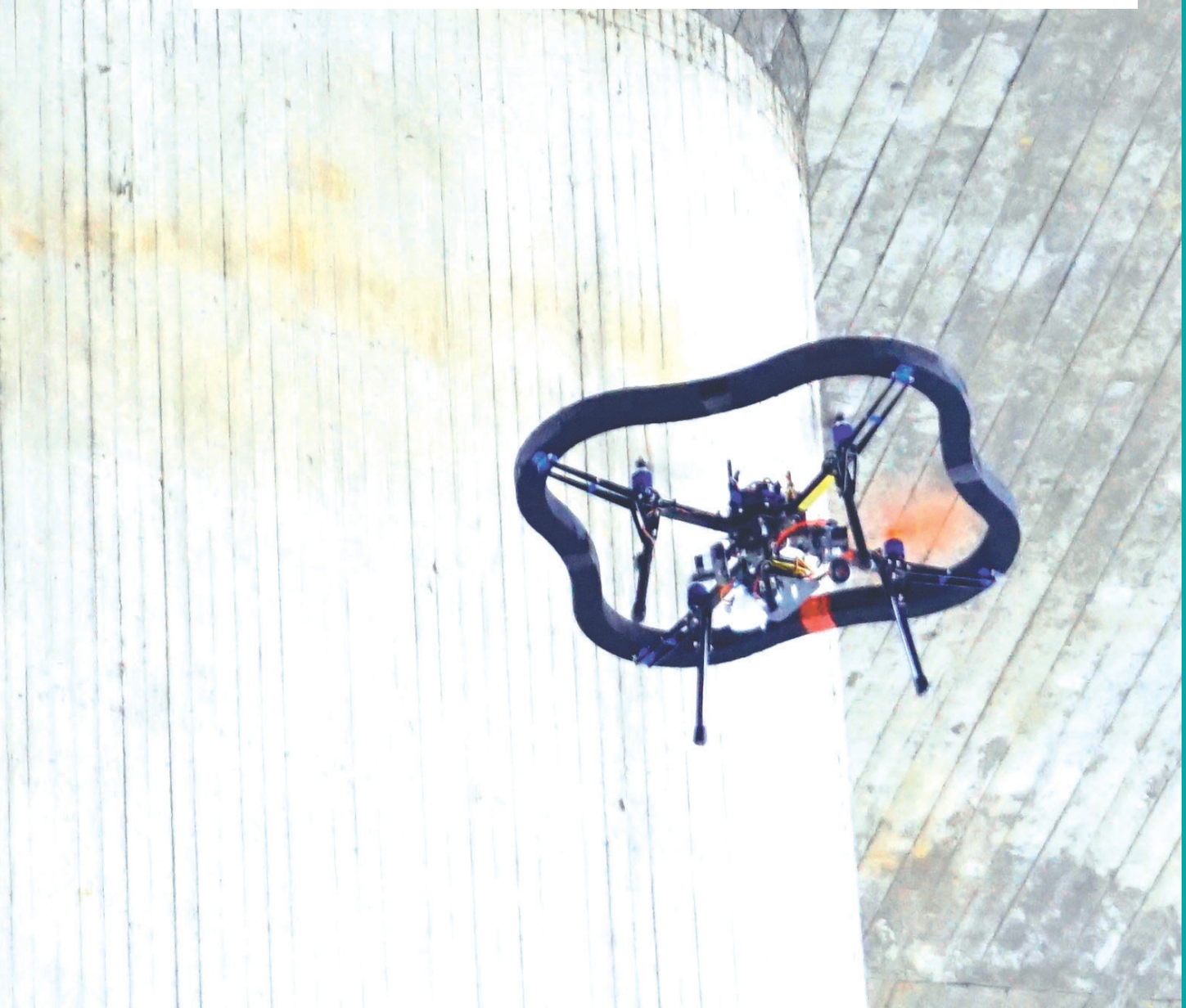
OBSTACLE DETECTION & COLLISION AVOIDANCE

Reliable detection of obstacles is essential for collision avoidance and optimal support of the pilot during flight!

In order to optimally assist pilots in critical situations, the Intelligent Flight Assistance System must obtain as comprehensive a picture of the environment as possible, from which corrective flight maneuvers are then calculated and executed.
Each application is different. This means that the sensor technology for environment detection depends on the copter's area of application. For this reason we have developed a portfolio of sensor modules that are optimized for different applications in each case. Due to the modularity of the sensor technology, the copters can be equipped cost-efficiently for the respective areas of application. The plug & play technology of the sensor modules enables existing copters to be quickly equipped with intelligent assistance functions such as obstacle detection, collision avoidance and active distance control.
Each sensor module is equipped with its own processor to evaluate the data acquired and to calculate corrective control values. Communication and intervention in flight control take place via standard interfaces such as USART or SBUS, so that a simple connection to all standard commercial autopilots is possible. In the development and production of all modules, we pay close attention to reliability, weight and energy efficiency from the outset in order to optimize flight performance.

CENTRAL CHARACTERISTICS OF OUR COLLISION AVOIDANCE MODULES

- Modular
- Plug & Play
- Serial communication
- Distance control
- Energy efficient
- Dedicated MCU
- Weight efficient
- Reliable



ULTRASOUND

Distance measurement with ultrasound is based on high-frequency sound waves. This technology is well suited to detect large-area and smooth obstacles. Compared to infrared sensors, ultrasonic sensors have no problems detecting transparent obstacles as well as obstacles in poor visibility or lighting conditions. They provide a cost-effective way to implement simple obstacle detection and collision avoidance. Processing the sensor data requires only low computing power.

Benefits:

- Simple data processing
- Efficient for detection of large objects
- Cost effective technology
- Independent of optical properties of obstacles
- Not affected by poor light and visibility conditions

Ideal application areas:

- Detection of walls
- Distance measurement to walls
- Flight close to glass facades

The CAA US-3 includes a CAA US+ and a central unit. One central unit is required per copter. The CAA US+ is the extension for one additional direction (front, left, right, rear).

CAA US-3

Hardware:	3 ultrasound sensors, central unit with IMU and MCU
Measuring range:	20 cm - 500 cm
Opening angle:	100° horizontal x 40° vertical
Framerate:	11 Hz
Resolution:	1 cm
Weight:	approx. 70 - 100 g
Measurements:	14 cm x 4 cm x 2 cm to 14 cm x 11 cm x 5 cm

CAA US +

Hardware:	3 ultrasound sensors
Measuring range:	20 cm - 500 cm
Opening angle:	100° horizontal x 40° vertical
Framerate:	11 Hz
Resolution:	1 cm
Weight:	approx. 50 - 80 g
Measurements:	14 cm x 4 cm x 2 cm to 14 cm x 11 cm x 5 cm

Errors and changes reserved.
All specifications are non-binding

INFRARED

Infrared distance sensors use light pulses for distance measurement. The reflection of the light pulse is detected and evaluated. The sensors are very well suited for medium-sized objects and also detect sound-absorbing surfaces where ultrasound fails. Optimally, these sensors are used inside buildings or complementary, i.e. together with other sensors, since interference occurs with this technology in very strong direct sunlight.

The measuring range of infrared sensors depends on the size, so that different sensors are used for different working areas. The sensors are small, inexpensive and lightweight. Transparent obstacles, such as glass, are not reliably detected. The two technologies, ultrasound and infrared, complement each other ideally and are an optimal solution for many applications.

Benefits:

- Simple data processing
- Efficient for detection of medium-sized objects
- Cost effective technology
- Detection of sound-absorbing surfaces

CAA IRL

Hardware:	8 infrared sensors in compact housing with IMU & MCU
Measuring range:	80 cm - 500 cm
Opening angle:	8 sensors à approx. 5° in 360° arrangement
Framerate:	10 Hz
Resolution:	1 cm
Weight:	approx. 200 g
Measurements:	13,5 cm x 13,5 cm x 6,6 cm

CAA IRM

Hardware:	8 infrared sensors in housing with IMU & MCU
Measuring range:	20 cm - 150 cm
Opening angle:	8 sensors à approx. 5° in 360° arrangement
Framerate:	10 Hz
Resolution:	1 cm
Weight:	approx. 200 g
Measurements:	15,5 cm x 13 cm x 3 cm

Errors and changes reserved.
All specifications are non-binding

LIDAR

LIDAR distance sensors based on laser pulses are characterized by their high precision and speed during processing. This enables very accurate and stable flight even under difficult conditions, such as turbulence.
The LIDAR sensors used have no moving parts and are small and lightweight. They also impress with a maximum measurable distance of up to 40 m and a precise measurement resolution of 1 cm.

Benefits:

- High range
- Fast processing
- Sharp ambient imaging

CAA L-8

Hardware:	8 point laser sensors in housing with IMU and MCU
Measuring range:	25 cm - 4000 cm
Opening angle:	8 sensors à approx. 1° in 360° arrangement
Framerate:	500 Hz
Resolution:	1 cm
Weight:	approx. 200 g
Measurements:	20 cm x 20 cm x 4 cm

CAA L-2

Hardware:	2 point laser sensors, Central unit with IMU and MCU
Measuring range:	25 cm - 4000 cm
Opening angle:	2 sensors à approx. 1° in 45° arrangement
Framerate:	500 Hz
Resolution:	1 cm
Weight:	approx. 80 g
Meaurements:	13 cm x 7 cm x 4 cm

CAA L+

Hardware:	2 point laser sensors
Measuring range:	25 cm - 4000 cm
Opening angle:	2 sensors à approx. 1° in 45° arrangement
Framerate:	500 Hz
Resolution:	1 cm
Weight:	approx. 80 g
Measurements:	13 cm x 7 cm x 4 cm

Errors and changes reserved.
All specifications are non-binding

The CAA L-2 includes a CAA L+ and the central unit. One central unit is required per copter. The CAA L+ is the extension for another direction (front, rear, left, right).

3D SENSOR TECHNOLOGY

Imaging sensors are characterized by high data density, which is important for flying through complex indoor spaces such as high-rack warehouses and industrial plants. This category includes the SV, PMD and RS sensor technologies. Due to the high data density, even relatively small or complex obstacles such as trees with leaves can be reliably detected.

Benefits:

- Sharp ambient imaging
- Large amount of data
- Detects even complex obstacles
- Use of image data possible
- 3D mapping / SLAM

CAA SV

Hardware:	Stereo camera with i7-CPU
Measuring range:	1 - 20 mm
Opening angle:	65° horizontal, 45° vertical
Framerate:	10 - 20 Hz
Depth resolution:	5 - 10 cm
Image resolution:	640 x 480 pixels
Weight:	approx. 250 g
Measurements:	16 cm x 2,5 cm x 1 cm plus CPU: 10 cm x 8 cm x 2,5 cm

CAA RS

Hardware:	3D time of flight camera Intel® RealSense™ with i7-CPU
Measuring range:	20 cm - 300 cm
Opening angle:	70° horizontal, 50° vertical
Framerate:	60 Hz
Depth resolution:	1 cm
Image resolution:	640 x 480 pixels
Weight:	approx. 300 g
Measurements:	auf Anfrage CPU: 10 cm x 8 cm x 2,5 cm

CAA PMD

Hardware:	3D time of flight camera PMD with i7-CPU
Measuring range:	10 cm - 400 cm
Opening angle:	62° horizontal, 45° vertical
Framerate:	45 Hz
Depth resolution:	1 mm
Image resolution:	224 x 171 pixels
Weight:	approx. 250 g
Measurements:	7 cm x 2 cm x 1 cm plus CPU: 10 cm x 8 cm x 2,5 cm

Errors and changes reserved.
All specifications are non-binding

COMPLEMENTARY SENSOR TECHNOLOGY

Complementary sensor technology combines the advantages of different sensor technologies and reduces the weaknesses of individual sensor types. For example, while ultrasound sensors have difficulty detecting sound-absorbing surfaces, they are not susceptible to interference when detecting transparent obstacles. Sensors operating with light waves, such as infrared and LIDAR, behave in exactly the opposite way, allowing these technologies to complement each other perfectly.

CAA UI

Hardware:	8 infrared sensors, 12 ultrasonic sensors, central unit with IMU and MCU
Measuring range:	60 cm - 500 cm
Framerate:	10 Hz
Resolution:	1 cm
Weight[1]:	approx. 400 g
Measurements:	see individual modules

CAA LU

Hardware:	8 point laser sensors, 12 ultrasonic sensors, central unit with IMU and MCU
Measuring range:	20 cm - 4000 cm
Framerate:	10 Hz
Resolution:	1 cm
Weight:	approx. 400 g
Measurements:	see individual modules

CAA UI mini

Hardware:	8 infrared sensors, 12 ultrasound sensors, central unit with IMU and MCU
Measurement range:	10 cm - 150 cm
Framerate:	10 Hz
Resolution:	1 cm
Weight:	approx. 400 g
Measurements:	see individual modules

Errors and changes reserved.
All specifications are non-binding

SENSOR SOLUTIONS AT A GLANCE

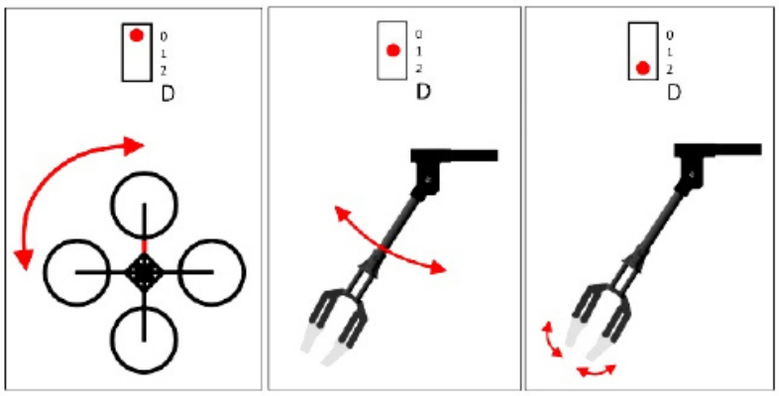
CAA	Reco-gnizes small objects	Cost efficient	Small and light	Detects glass, mea-sures through smoke	Detects sound-absor-bing surfaces	Detects low contrast surfaces	High range	Near mea-suring distance	High recovery rate
US-3	−	+++	+++	+++	−	+++	++	++	+
IRL	−	++	++	−	+++	+++	++	−	+
IRM	−	++	++	−	+++	+++	+	++	+
L-8	−	++	++	−	+++	+++	+++	++	+++
L-2	−	+++	+++	−	+++	+++	+++	++	+++
SV	++	+	++	−	+++	−	++	−	+
RS	+++	+	++	−	+++	++	+	++	+
PMD	+++	+	++	−	+++	++	+	+++	+
UI	−	+	+	+++	+++	+++	++	−	+
LU	−	+	+	+++	+++	+++	+++	++	++
UI mini	−	+	+	+++	+++	+++	+	++	+

The Quanipulator - The Flying Hand

A robot that performs work at high altitudes, which can otherwise only be reached with large and expensive lifting platforms, is no longer science fiction!
Equipped as a flying multicopter with a gripper arm, the Quanipulator is exactly what you would call THE universal tool of the future!

SMART TECHNOLOGY FOR TANGIBLE PROGRESS IN RESEARCH

The Quanipulator is a quadrocopter equipped with a pivoting gripper arm. Like any ordinary drone, it can be freely maneuvered in six degrees of freedom via a remote control. The gripper arm can be swivelled up and down as well as opened and closed via the same remote control. With the necessary flying experience, the precise transport and placement of objects is already possible today!



Similar to our teaching system, also called Quadrotor Control System (QCS for short, see page 12), the Quanipulator is freely programmable via a software framework. It also has numerous interfaces for attaching and integrating sensors as well as function modules.
Its range of features is constantly being expanded.

This allows you to customize the Quanipulator perfectly according to your wishes and ideas!

Technical features:

Control:	Manual, semi-autonomous
Performance:	approx. 1200 W
Span width:	approx. 70 - 180 cm
Unloaded weight (without battery):	approx. 2000 - 12000 g
Pickup weight:	approx. 200 - 5000 g

Delivery of the standard system includes:

- Quanipulator quadrocopter
- Integrated 2DOF gripper arm
- Powerful motors
- 3000 mAh 4S LiPo-battery
- Radio remote control
- Propeller guard
- 4 + 4 12“ propellers
- Programming interface
- Comm.: SPI, I2C, UART
- Software library
- Sample software
- Documentation
- Manual

For an easy start we will also provide you with all the necessary software tools and drivers.

For design reasons, the masculine form has occasionally been used to address persons of all genders.
All illustrations of products in this brochure are exemplary and may differ from the actual appearance.

www.emqopter.de

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