



# Mobile outdoor robots

## Robots for use in agriculture, forestry, outdoor logistics and other sectors

*Agricultural robotics prototype CURTdiff in test operation in a potato field. Source: Fraunhofer IPA*

The research group “Professional Service Robots – Outdoor” at Fraunhofer IPA develops outdoor robots for complex application scenarios. The basis for this is the CURT robot system.

### Challenges and objectives of the CURT system

From a robotics perspective, outdoor environmental conditions are particularly challenging because they vary greatly depending on the context and have a poor but highly variable structure. Examples include uneven terrain, vegetation, different surfaces, and varying weather conditions. In addition, dirt such as mud, dust swirls or other organic substances hamper the measurements of imaging sensor technology such as LiDAR and cameras.

The aim of the robotic system CURT: to enable robots to be used for these challenging application areas as robust, flexible development platforms in a productive way. There are currently two versions of CURT: **CURTmini** for permanent crops,

intralogistics in outdoor areas or even disaster control, and **CURTdiff** for arable farming.

### CURTmini

The small mobile robot CURTmini is a compact research platform which, thanks to rocker kinematics - a special compensating chassis - can cope with extremely rough terrain. Furthermore, the chassis minimizes sensor movements due to unevenness. CURTmini serves primarily as a platform that greatly accelerates development services. It is not intended to be a highly specialized solution, but rather a quick technological starting point. With the option of integrating different sensor configurations into CURTmini via plug & play, and with a payload of up to 20 kg, it can be used to roughly demonstrate many exemplary application processes and verify their feasibility. The navigation software enables the robot to move autonomously. CURTmini is also available in a waterproof and dirt resistant version.



Mobile robot for various areas of application, including inspection tasks: CURTmini.

Source: Fraunhofer IPA

## CURTdiff

Due to the special structure of the environment in arable farming, a further version of the robot is required in addition to CURTmini. CURTdiff is built to run over a wide variety of crop rows. It has a differential drive, meaning that it has two actively driven wheels and two passive castor wheels. It also has a ground clearance of over one meter. The sensor setup can also be configured and integrated on a modular basis. For autonomous navigation especially in fields, camera- and LiDAR-based row tracking software has been developed, which allows CURTdiff to move autonomously. In addition, special manipulators and tools, e.g. for mechanical crop protection, can be attached to the robot's modular interfaces. CURTdiff was developed on a modular basis, thus enabling it to be quickly adapted to new environmental scenarios.



CURTdiff in its second generation. With a new chassis and new actuators, it represents a further development of the first prototype.

Source: Fraunhofer IPA

## Your advantages

CURT users and developers receive highly-integrated hardware and software solutions from a single source. CURT can be adapted to many applications. As a result, joint developments between Fraunhofer IPA and industrial customers can be implemented in a time- and cost-efficient manner. CURT is more than just the system. Thanks to its high modularity, each of CURT's components, whether hardware or navigation software, can be transferred to other agricultural machines. Application examples include:

- Use of the navigation software:
  - In automatic feeders in stables
  - In diverse logistics environments
  - In machines at airports
  - Robots for last-mile delivery
- Use of field row detection by harvesting machines
- Prototype development with CURTmini:
  - Construction industry
  - Permanent crops in agriculture

## Our services

Fraunhofer IPA is a cooperation partner for industry as a technology consultant, development partner and technology supplier for all matters concerning outdoor service robotics for professional use. This includes the following services:

- Execution of market, profitability and feasibility studies
- Development of prototypes for hardware as well as autonomous outdoor navigation:
  - Conception and realization of service robots for the aforementioned application areas
  - Conception and realization of sub-technologies for autonomous machines
  - Adaptation and modification of outdoor navigation software for specific application areas
- Joint development with technology users right up to the point of productive operation
- Adaptation and further development of existing machines and systems

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