## The future of autonomous firefighting

State-of-the-art, remotely operated fire-fighting vehicles can extend the reach of fire-fighting operations while significantly improving the safety of personnel. The integration of artificial intelligence (AI) could make even greater autonomy possible in the future.

Alpha Robotics, based in Vechta, Germany, recognised years ago that traditional firefighting vehicles and tactics were falling short of their potential, despite the availability of modern technology. Founder and CEO Oliver Rasche, himself an active firefighter, developed the first prototype of a tactical firefighting robot in 2016. The Wolf R1 is an unmanned ground vehicle (UGV) and a versatile platform for a wide range of tasks. After an intensive testing phase, the model went into production. To date, around 50 vehicles have been sold and the Wolf R1 is in service worldwide.

## Operations in hard-to-reach areas

Compact and manoeuvrable, the Wolf R1 measures 1.50 metres long, 1.20 metres wide and 1.30 metres high. This makes it ideal for confined or hard-to-reach areas such as forests or marshland. Powered by an electric track system, it can negotiate rough terrain without sinking. The "Wolf", as its creators call it, can pull up to 200 metres of water-filled hoses weighing about a ton and deliver up to 3,000 litres of water or foam per minute at a range of 70 metres. "This enables efficient work even in large fires or in areas that are difficult for humans to access," explains Philipp Hartke, an employee at Alpha Robotics.

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**Remote control via handheld device or mobile command centres**

The Wolf R1 is controlled via a remote handheld device or mobile command centres in emergency vehicles, significantly reducing operational risks. Camera images and sensor data allow precise control over long distances of up to 2.5 kilometres. The vehicle is also equipped with various support systems, including headlights, cameras, a recovery winch and a logistics platform that can be used to transport heavy pumps or rescue stretchers.

**Robotics offers new opportunities in traditional fields**

The Wolf R1 demonstrates how robotics can open up new opportunities in traditional fields such as firefighting. By integrating AI and using technologies such as lidar sensors, high-resolution cameras and machine learning (ML), the robot could achieve even greater autonomy in the future. While it is currently fully remote-controlled, developers are working on algorithms that will enable the robot to identify obstacles and calculate alternative routes on its own. This would be particularly useful in situations such as forest fires or rough terrain. The robot could also play a crucial role in operations where human lives are at risk. For example, in industrial facilities with high temperatures or buildings at risk of collapse, an autonomous Wolf R1 could work without human intervention to locate fire sources.



"However, such advances face regulatory and insurance challenges similar to those facing autonomous driving," notes Hartke. A key question is what happens if the robot makes an incorrect decision, such as failing to navigate around an obstacle? "These scenarios pose not only technical but also legal challenges. A clear legal framework needs to be established," says Hartke.

**Hybrid system to gain acceptance**

Another important aspect is acceptance within the fire service, as autonomous systems must not only prove their technical capabilities, but also earn the trust of firefighters. "The goal is to find a balance between technical support and maintaining human control," explains Hartke. The Wolf R1 already provides a solid foundation with its hybrid control system: fully manual, semi-autonomous or - in the future - fully autonomous.

Another advantage is the reduction in manpower requirements. The Wolf R1 can already perform complex tasks with a single operator that would otherwise require a team of firefighters. An exciting future scenario is the simultaneous use of several robots working together autonomously. Using swarm intelligence, several vehicles could work in concert to water large areas at the same time, for example, or to attack a fire from different angles. While such concepts are still in the research phase, the technical foundation of the Wolf R1 already supports these applications.



**Showcasing innovation at XPONENTIAL Europe**

The Wolf R1 will be showcased at XPONENTIAL Europe, an event that brings together experts in autonomous systems and robotics from 18 to 20 February in Düsseldorf, Germany.

The DRONERESPONDERS European Public Safety and Emergency Forum, which takes place on 18-19 February as part of the exhibition, will also discuss topics such as disaster relief, firefighting and search and rescue.

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