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Layout, detail design, manufacturing, and field testing of a UGV for agricultural applications

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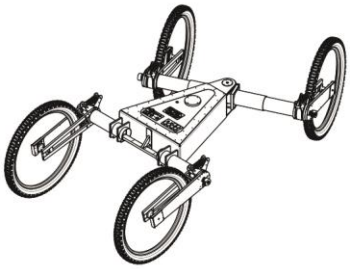
The surveillance of crops is a labour intensive task even in highly developed agricultural establishments. The utilisation of unmanned ground vehicles (UGV) for autonomous data acquisition offers significant improvement possibilities for operational procedures in a vast field of industrial processes. This new technological trend also facilitates promising possibilities to improve operational procedures in agricultural applications.
The present work includes the layout and detail design, manufacturing and field testing of a UGV for agricultural applications and is based on the focus project PA13_hsbh_5.
An autonomous UGV is exposed to harsh condition when used in an agricultural environment. Thus special requirements must be fulfilled. In order to cause minimal damage to the crops a narrow design of the running gear and a minimal ground clearance of 400 mm is required. Care is taken that the design of the individual components allows the use of simple manufacturing methods. Most Components can be manufactured in the available facilities of an experimental machine shop. Components with more complex forms are designed as sheetmetal parts and thus can be manufactured cost-efficiently on a CNC laser-cutting machine. Further, to maximize the reliability of the sensor system the UGV must have smooth running characteristics. Hence the running gear is designed using 29 inch wheels and damping elements. To enable universal usage on differently cultivated fields the track width of the UGV can be varied between 800 and 1200 mm by means of telescopic extensions on which the running gear is assembled. With the motor units located inside the tubular extensions the running gears can be folded together and thus allowing compact storage dimensions.
First tests were successfully performed. The UGV showed smooth running conditions and stable steering behaviours even on rough and sloped fields. Thus the UGV complies with the core requirements. An additional test was performed on a rough, sloped meadow at maximum speed. The drive trains showed unexpected rough running conditons and therefore caused damage to the chain drive. The design of the chain drive was altered in order to address that weak point. The field tesing will be continued after arrival of the required replacement components. After tests of the new drive train design the UGV is ready for pay load integration.

Prototype performing testing procedures



CAD model of the UGV