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Evaluating the PORTABILITY of the FROBOMIND ROBOT SOFTWARE architecture to new AUTONOMOUS PLATFORM
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Introduction
The University of Heidenheim (UnIH) is conducting research in novel precision agriculture production methods which involve crop scouting and scouting-aided weeding applications etc. and are collaborating with the University of Southern Denmark on utilizing autonomous field robots in those projects. UnIH has a field robot platform Autonomous Mechanisation System (AMS) which was retrofitted with several sensors for navigation along with the controller system. FroboMind (Beck et al., 2010) was developed for autonomous operation. All actions on the AMS were achieved by using an electronic control unit (ECU) (Fig. 4) as a ROS-JAX, from Sensemachanix Wismarland. The safety interlocks and emergency shutdowns were achieved with a combination of stamp-controllers (with PIC microcontrollers), radio links, and hardened relays. The safety circuit was developed as a result of the Safe and reliable project (Griepentrog et al., 2009). The tractor navigation controller was designed to follow a predetermined route plan accurately and repeatedly across a field with planned action points for implement control (Blackmore et al., 2007). Blackmore et al., 2004. Griepentrog et al., 2009.

Materials and methods
Autonomous Mechanisation System - The Hako tractor
The AMS (Fig. 1) is the Hako tractor that was used as the target platform is a part of an advanced robotic crop establishment and control system based on Precision Agriculture-principls, and was developed by University of Copenhagen in cooperation with the Department of Automation of the Technical University of Denmark (DTU). The AMS is currently being further developed at the Department of Instrumentation and Test Engineering at University of Heidenheim. AMS is based on a conventional 20 kW tractor (Hakotrac 3000) which was retrofitted with several sensors for navigation along with the controller system. FroboMind (Beck et al., 2010) for autonomous operation. All actions on the AMS were achieved by using an electronic control unit (ECU) (Fig. 4) as a ROS-JAX, from Sensemachanix Wismarland. The safety interlocks and emergency shutdowns were achieved with a combination of stamp-controllers (with PIC microcontrollers), radio links, and hardened relays. The safety circuit was developed as a result of the Safe and reliable project (Griepentrog et al., 2009). The tractor navigation controller was designed to follow a predetermined route plan accurately and repeatedly across a field with planned action points for implement control (Blackmore et al., 2007). Blackmore et al., 2004. Griepentrog et al., 2009.

FroboMind
FroboMind is a conceptual architecture for field robot control software. The FroboMind architecture (Fig. 3) is optimized for precision agriculture and similar field robotics research projects with respect to the parameters modularity, reliability, extensibility, scalability, and code reuse between different robot platforms and applications. At the current development state FroboMind is not considered to be stable or reliable enough for production use. In this project we have used the latest software submitted to the FroboMind repository at 2012-03-23. In this project FroboMind interfaces to the ECU. The FroboMind computer communicates with the ECU through a CAN bus.

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