

Development of a fully autonomous tractor for sustainable agriculture

Ferry Schoenmakers – Nobleo Technology



Intro

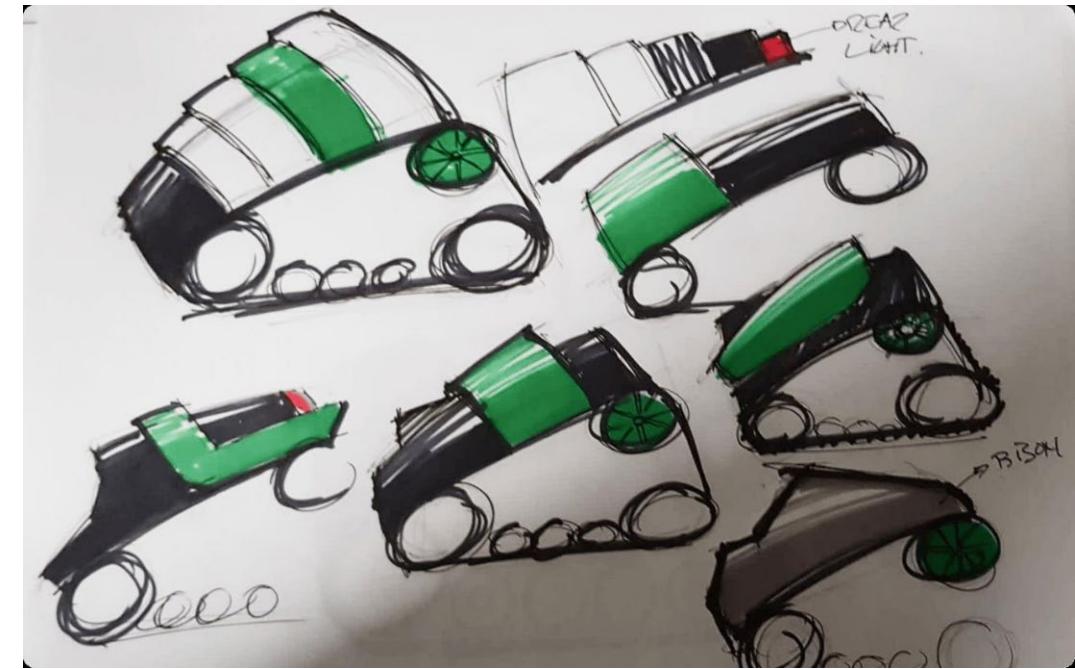
- The Idea
- The partners
- AgBot design
- Software design
- Digital twin
- Results



The Idea

From idea to company

- AgXeed was founded in summer 2018
- Founders: Joris Hiddema (CEO), Lars Schmitz (CTO), Sander Pop (COO), Rienk Landstra (CFO/CPO) all with a background in agricultural machinery
- Break the trend of ever bigger and heavier machinery
 - free farmers from the need to spend endless monotonous hours in their cabin
 - free the soil from the ever-increasing weight of modern tractors
- Fully autonomous machine, start from a blank sheet of paper
- First fully functional prototype in December 2019
- Commercial sales since 2022



The Partners

Combine forces



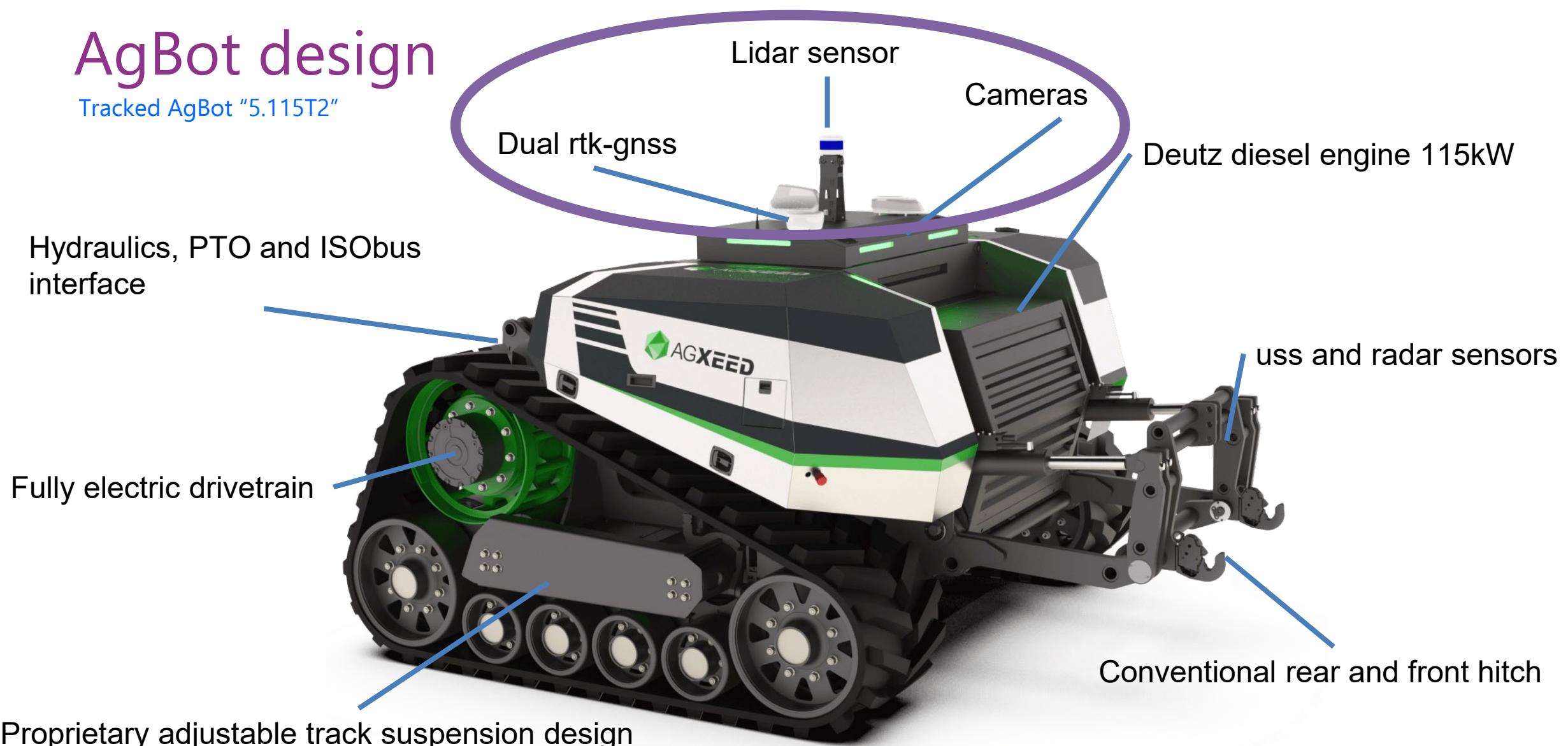
AgBot design

Tracked AgBot "5.115T2"

Hydraulics, PTO and ISObus interface

Fully electric drivetrain

Proprietary adjustable track suspension design



AgBot design

Other AgBots



AgBot 2.055W4
Light soil work and maintenance



AgBot 2.055W3
Smart orchard applications

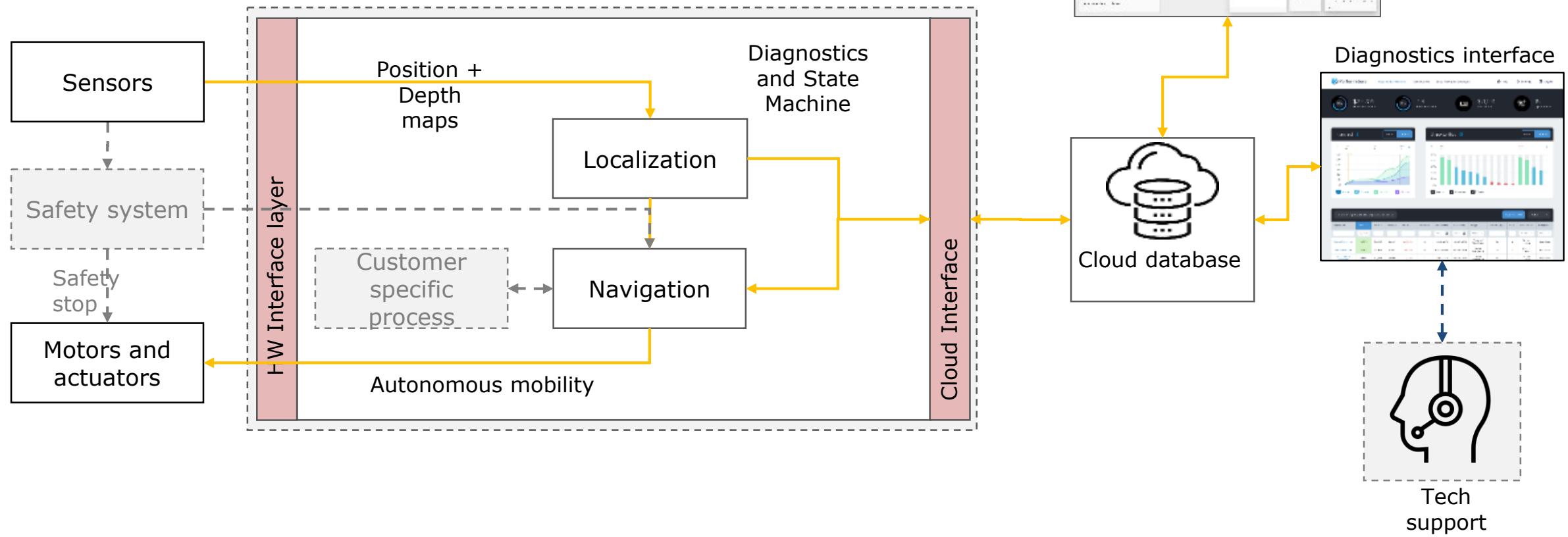
AgBot design

Design choices

- Diesel electric design for fine control but realistic weight and operation time
- Relatively light weight (<8t) to avoid soil compaction
- Conventional hitch interface for existing implements
- Electric PTO and ISObus + high-voltage implement interface
- Adjustable tracks/tires and working width
- Data link for live monitoring, data collection and control
- Web portal for task planning and device management

Software design

Software stack based on Nobleo-core ROS-stack



Software design

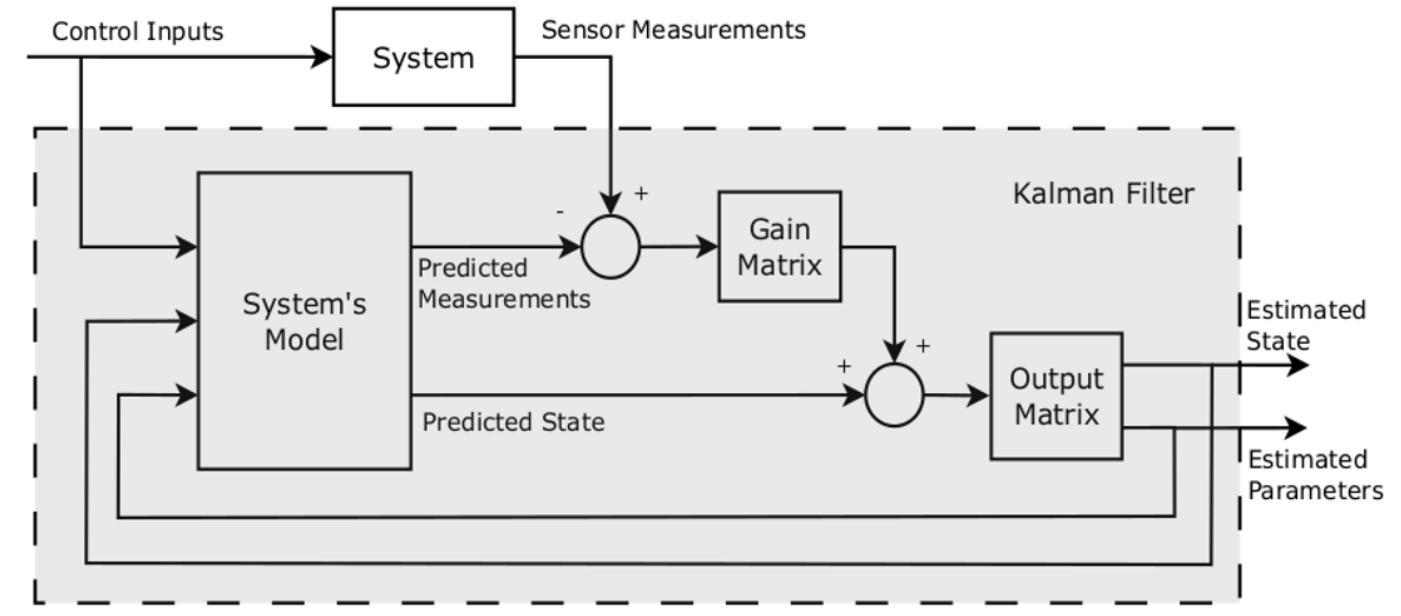
Design choices

- Based on proven Nobleo-core
- Custom nodes for AgBot related hardware interfacing
- Single software deployment for ALL AgBots, cloud configurable
- Deployment via dockers and Balena, full rollbacks possible
- Safety critical software parts run in parallel on dedicated hardware
- Authorized personnel has full remote access to all signals for remote support
- On critical events snapshots of full datasets are available for debugging and maintenance

Software design

Sensor fusion

- Kalman filter sensor-fusion concept
- Our inputs:
 - Dual rtk-gnss
 - Gnss heading
 - Dual IMU (AHRS)
 - Wheel encoders (Odometry)
- Challenges:
 - Trees
 - Powerlines
 - Slip

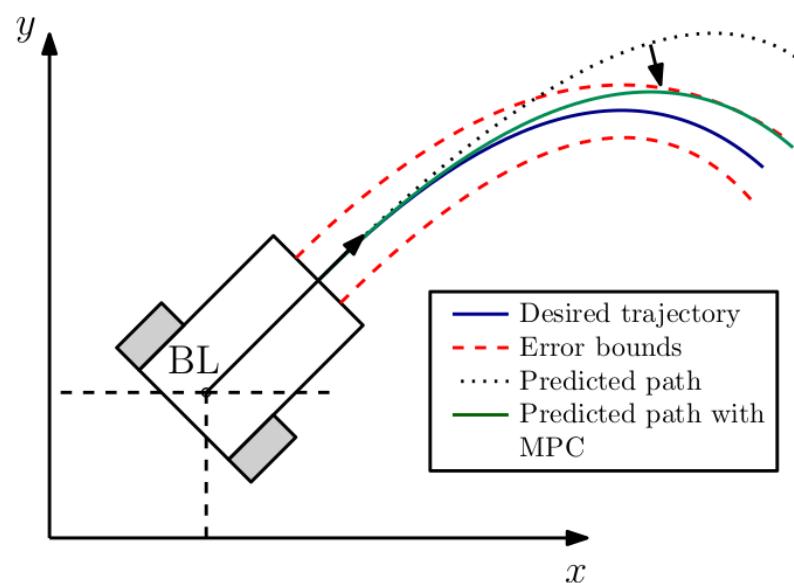


Full article in Mikroniek Issue 5 – 2020

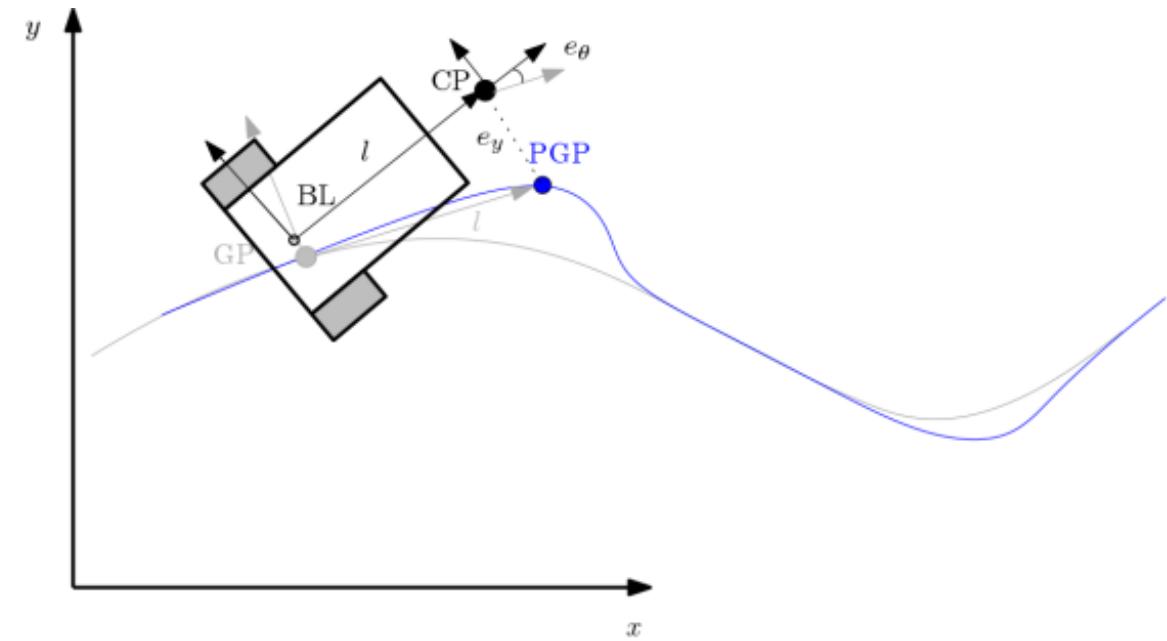
Software design

Path tracking

- In principle a PID-controller
- With feedforward
- And "MPC" feature



Full article in Mikroniek Issue 5 – 2020

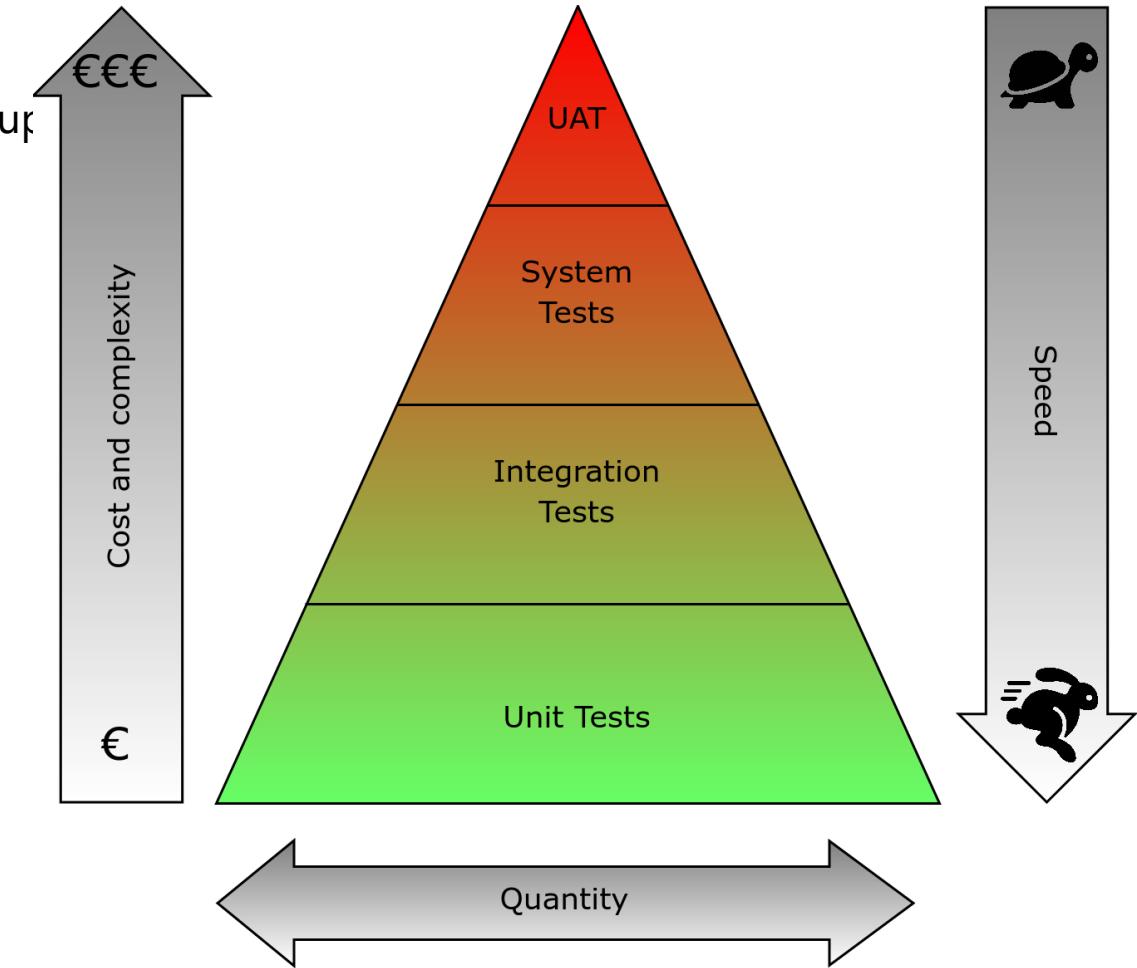


- BL – Baseline
- CP – Control point
- GP – Goal point
- PGP – Projected goal point

Digital Twin

Full software simulated machine

- Software tests are typically expensive and slow, the further up you go in the pyramid
- Full virtual AgBot operational months before proto
- Simulation up to CANbus interface
- Identical cloud interface
- First prototype driving 2 weeks after 'turning the key'
- Approximately 400 hectare of virtual field done before
- Still helpful tool for testing future software releases



Full article in Mikroniek Issue 2 – 2022

Results

- Fast development because of joint forces
- Nobleo-core based software allowed for quick development
- Digital twin proven to be very valuable

Results



Results



Results



https://youtu.be/aPBt_wHoafw

Questions?

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- Very interested?
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