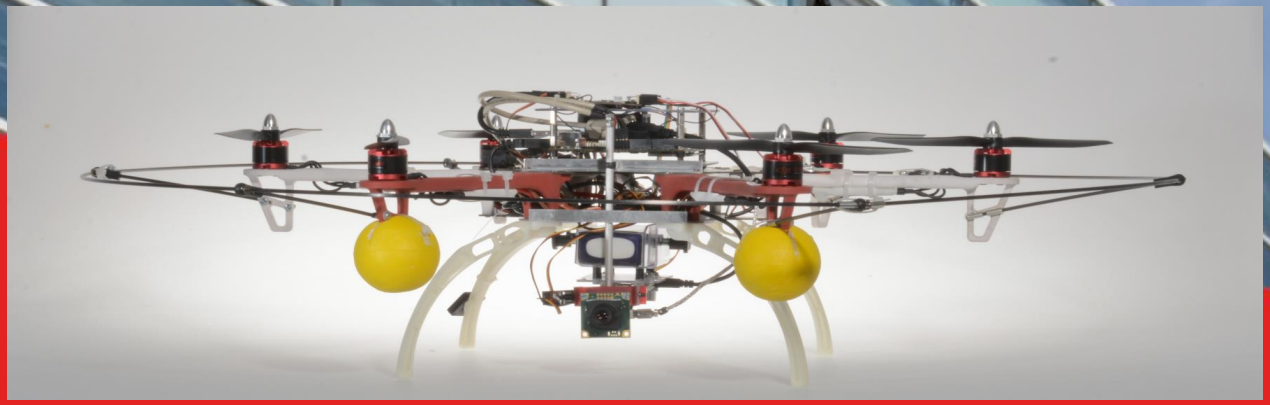

Slimme toepassingen met Unmanned Aerial Vehicles (UAV's)

Studie dag Big Data
Aansluitingsnetwerk vo-ho Fryslân
24 juni 2016

Jaap van de Loosdrecht
Lector Computer Vision
Kenniscentrum Computer Vision
NHL Hogeschool Leeuwarden

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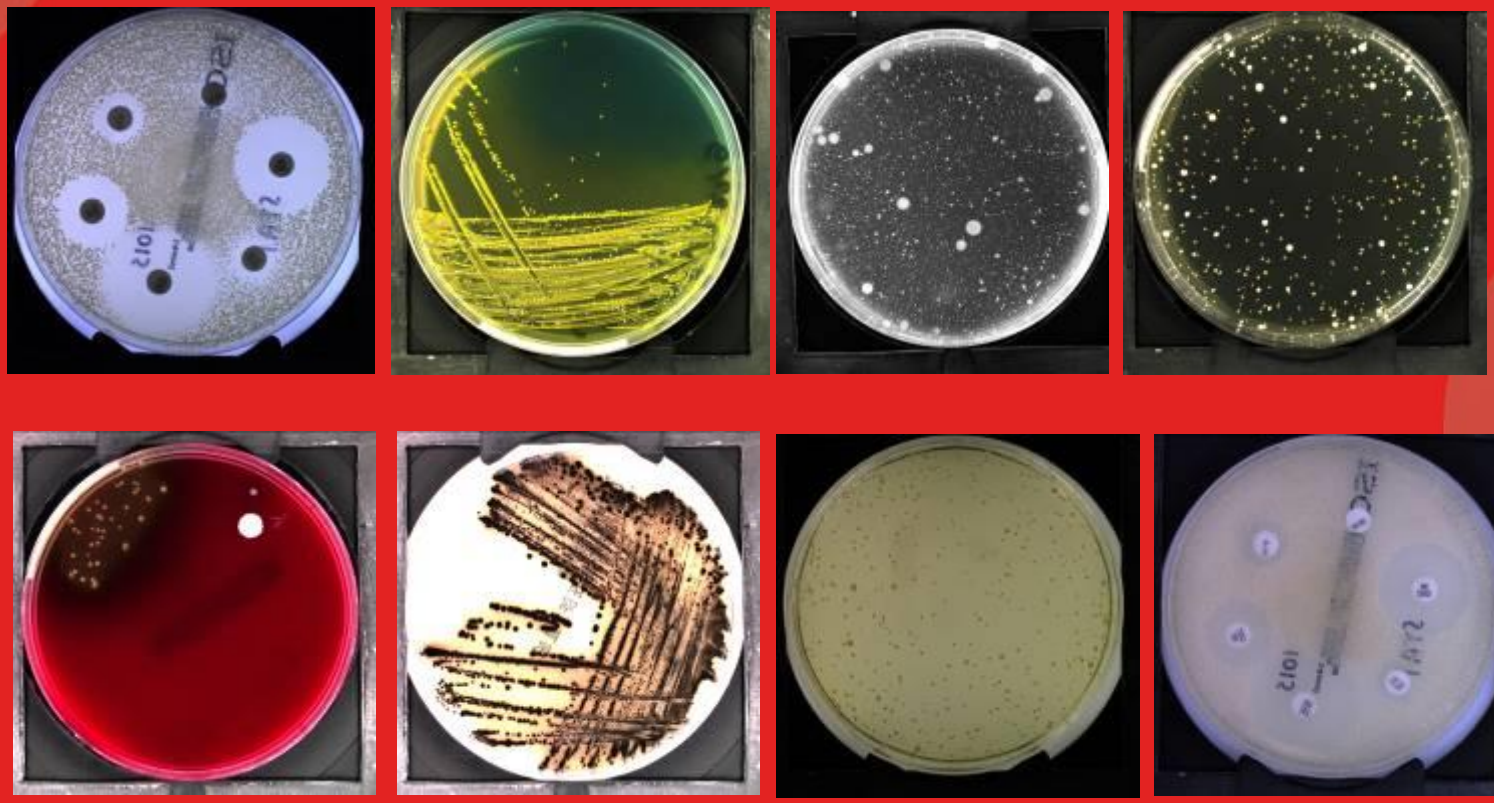
Overzicht

- Wat is Computer Vision?
- NHL Kenniscentrum Computer Vision
- Drones of Unmanned Aerial Vehicles (UAVs)
- Conclusie

Inspectie petrischalen



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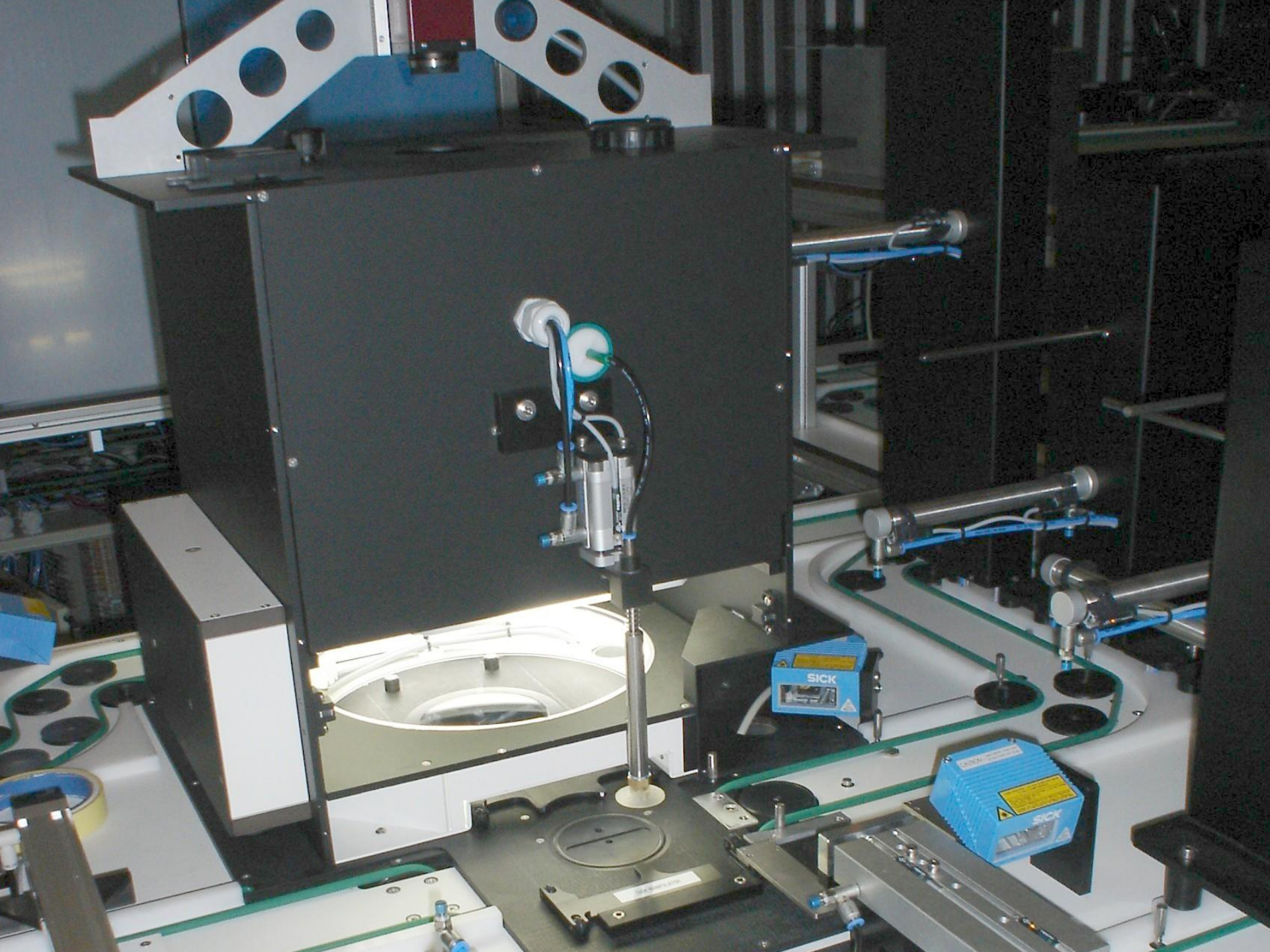
Bartec


SICK
SICK

23rd European Congress of Clinical Microbiology and Infectious Diseases, Berlin 27-30 April 2013

End-user trainable automatic antibiotic-susceptibility testing by disc diffusion using machine vision

K. Dijkstra[1], M. Berntsen[2], J. van de Loosdrecht[1] and W. J. Jansen[1]

1) NHL University of Applied Sciences, Center of Expertise Computer Vision, Leeuwarden, The Netherlands. 2) BD, Drachten, The Netherlands.

Objectives

BD Kiestra provides a workflow where digital images of Petri-dishes used in antibiotic susceptibility testing by disc diffusion can be automatically analyzed using machine vision algorithms.

The objective of this study is to develop and test a system which automatically optimizes a zone measurement algorithm to yield results close to zone measurements of a human end-user.

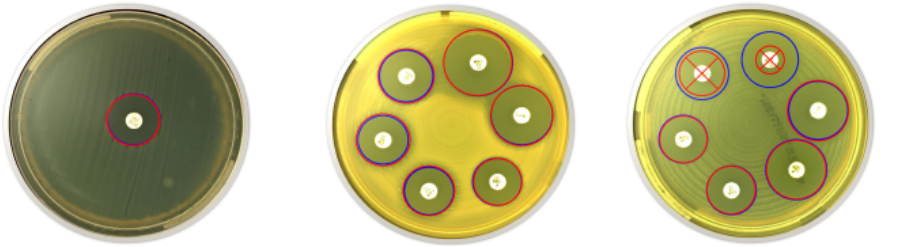
Methods

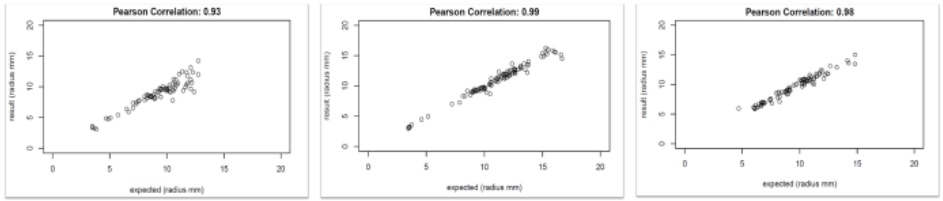
The main design principle is that the lab technician does not have to know anything about machine vision to train the system. Technical configuration is handled by Artificial Intelligence.

Three digital image sets of Petri-dishes using different illuminations from two European microbial laboratories have been selected from the daily routine to test the system. Evaluation is performed using a two-fold cross-validation.

Results

Blue and red circles are manual and automatic measurements respectively.
Crossed circles are automatically rejected measurements.





Accepted:	76 of 76 zones	Accepted:	100 of 100 zones	Accepted:	96 of 152 zones
Correlation:	0.93	Correlation:	0.99	Correlation:	0.98

Conclusions

An end-user trainable machine vision system for measuring zones is presented and compared to manual zone measurements.

The proposed method shows excellent correlation between manually and automatically measured zones.

In low contrast image environments the system adapts by automatically rejecting more zones maintaining high Pearson correlation.

BD Kiestra™

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Cattle Care

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LapVas (LIMIS, MCL)

Doel: verminderen naadlekkage bij darmoperaties

Meten kwaliteit van weefsel van de darmwand (microcirculatie)

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NHL Kenniscentrum Computer Vision

- Gestart in 1996
- Onderdeel NHL Hogeschool, Instituut Techniek
- 1 Lector (1 fte)
- 1 Onderzoeker (1 fte)
- 5 Project engineers (6.4 fte)

- Stagiairs / afstudeerders
  Totaal, vanaf start: 450 uit Nederland en 45 uit buitenland

NHL Kenniscentrum Computer Vision

Kernactiviteit

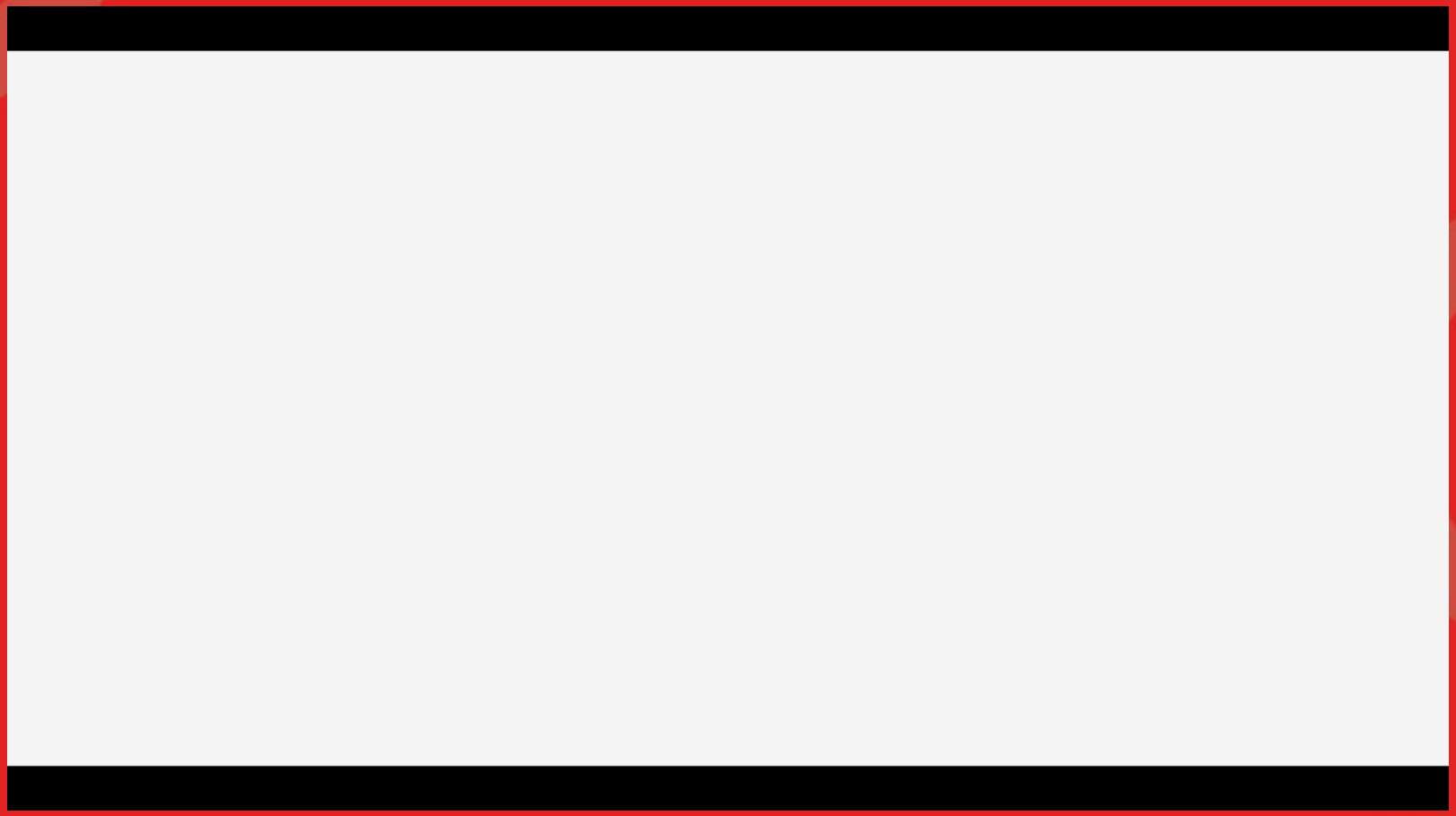
- **Computer Vision**
  Optiek, belichting, camera techniek, algoritmiek en het embedden in toepassingen

Speerpunten

- **Data Science (Big Data)**
  Patroonherkenning en optimalisatie technieken (Kunstmatige Intelligentie en Statistiek)
- **Parallel Computing**
  Versnellen van sequentiële algoritmen door deze te parallelliseren voor commodity parallelle hardware, zoals multi-core CPU en/of GPU systemen
- **Sensor Fusion**
  Data afkomstig van meerdere, en mogelijk van verschillend type, sensoren te combineren tot informatie


Computer Vision

Video Smart Vision for UAVs



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Drones in civiele toepassingen met camera’s

- Commerciële operators die diensten aanbieden met drones bestuurt door grondpiloten mbv GPS-waypoints
- Commodity producten, bijvoorbeeld: DJI Phantom

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Geautomatiseerd vliegen mbv GPS way-points

Van GPS positie naar GPS positie met gespecificeerde hoogte en snelheid

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Geautomatiseerd vliegen mbv GPS way-points

Global Positioning System

Flight controller

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Smart Visions for UAVs

- RAAK SIA MKB project
- September 2014 – September 2016
- 15 bedrijven en instellingen
- Marktvragen:
  - Wind turbine inspectie
  - Detectie en inspectie van vuurhaarden
  - Inspectie van landbouwgronden
  - Schouwen van sloten

SiA
Nationaal Regieorgaan
Praktijkgericht Onderzoek

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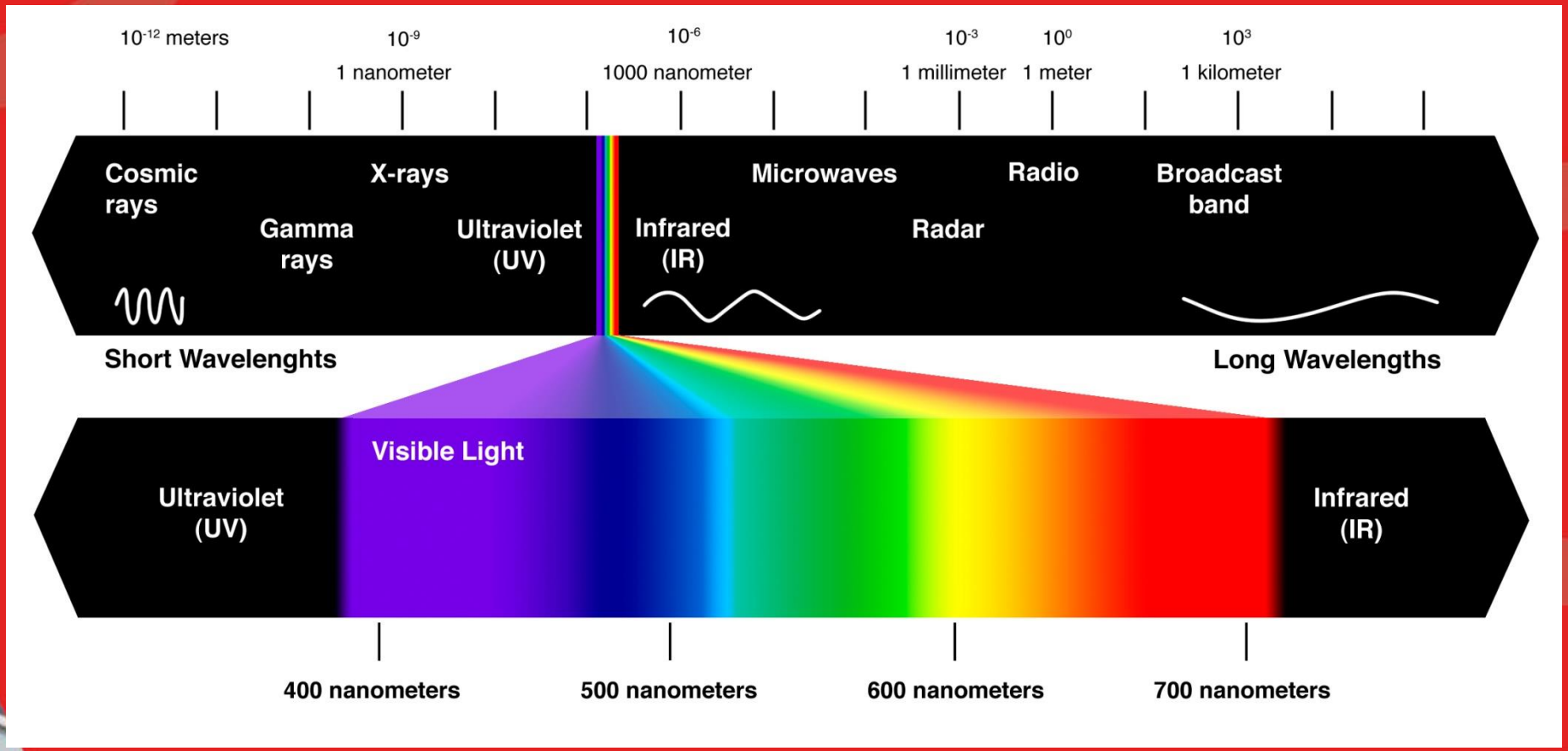
Wind turbine inspectie

Smart Vision for UAVs

Onderzoeksvragen:

- **Kunnen met behulp van UAVs voldoende kwalitatief goede opnames worden gemaakt om de gevraagde inspectie uit te voeren?**
- **Kan de beoordeling van deze beelden worden geautomatiseerd en in welke mate?**
- **Kan het vliegproces worden ondersteund en/of geautomatiseerd?**
- **Kan worden voldaan aan de wettelijke regelgeving met betrekking tot het bedrijfsmatig gebruik van UAVs?**

Elektromagnetisch spectrum



Camera’s for breed-spectrum experiment

- Thermal
- Hyperspectral NIR
- Visible light
- Hyperpectral VIS
- Thermal
- HDR
- Short Wave IR
- Near IR

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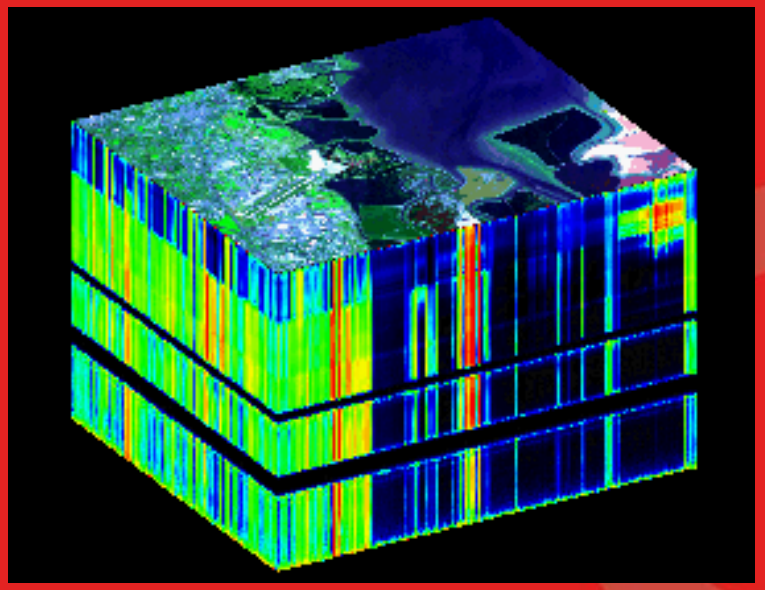
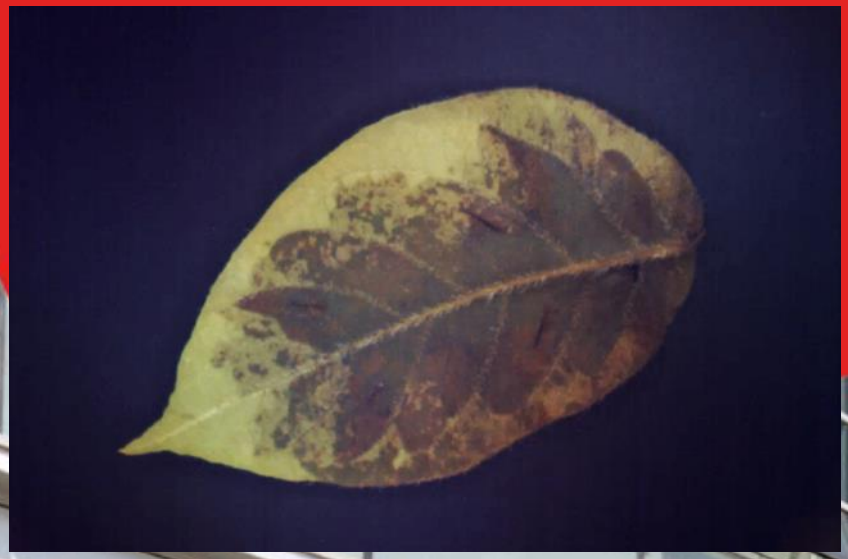
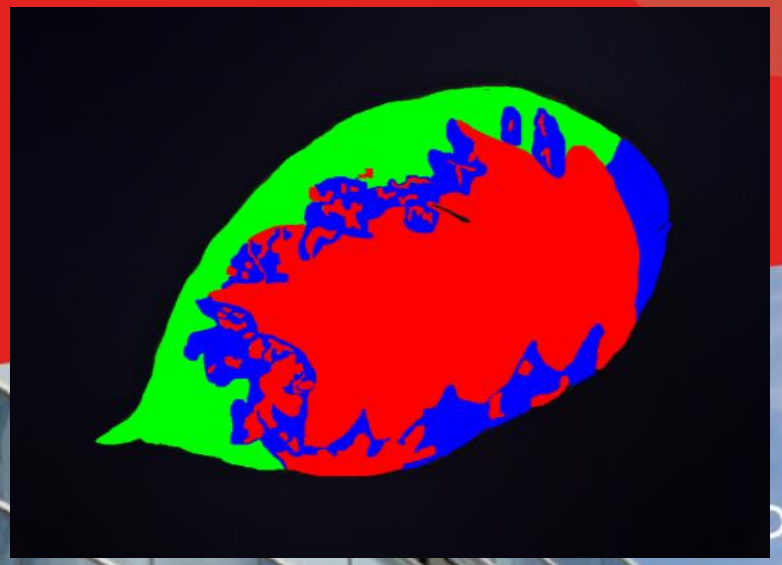
Landbouwgrond inspectie

Detectie aardappelziekte







Geautomatiseerd vliegen mbv GPS way-points

Global Positioning System

Flight controller

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NHL Twirre architecture

Global Positioning System

Flight controller

Local Positioning System

sensors

Automatic navigation of UAVs

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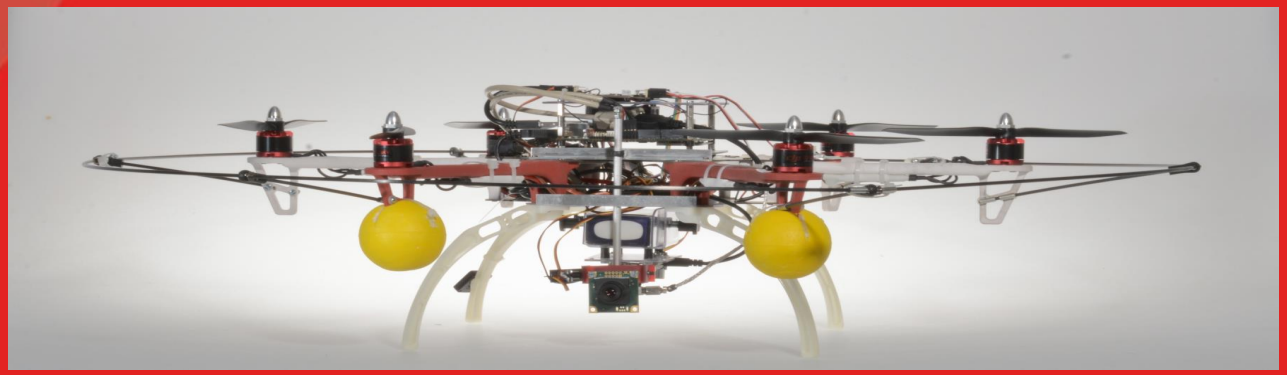
Landing

Follow pointer

Inspection

Look around

Twirre architecture for automated UAVs using interchangeable commodity components



Uitganspunten

- Alle intelligentie on-board
- Geen ontwikkeling hardware, UAVs en flight controllers
- Geen ontwikkeling software flight controllers
- Standaard componenten
  - Goedkoop
  - Uitwisselbaar
  - Uitbreidbaar
- Betrouwbare interventie manuele besturing

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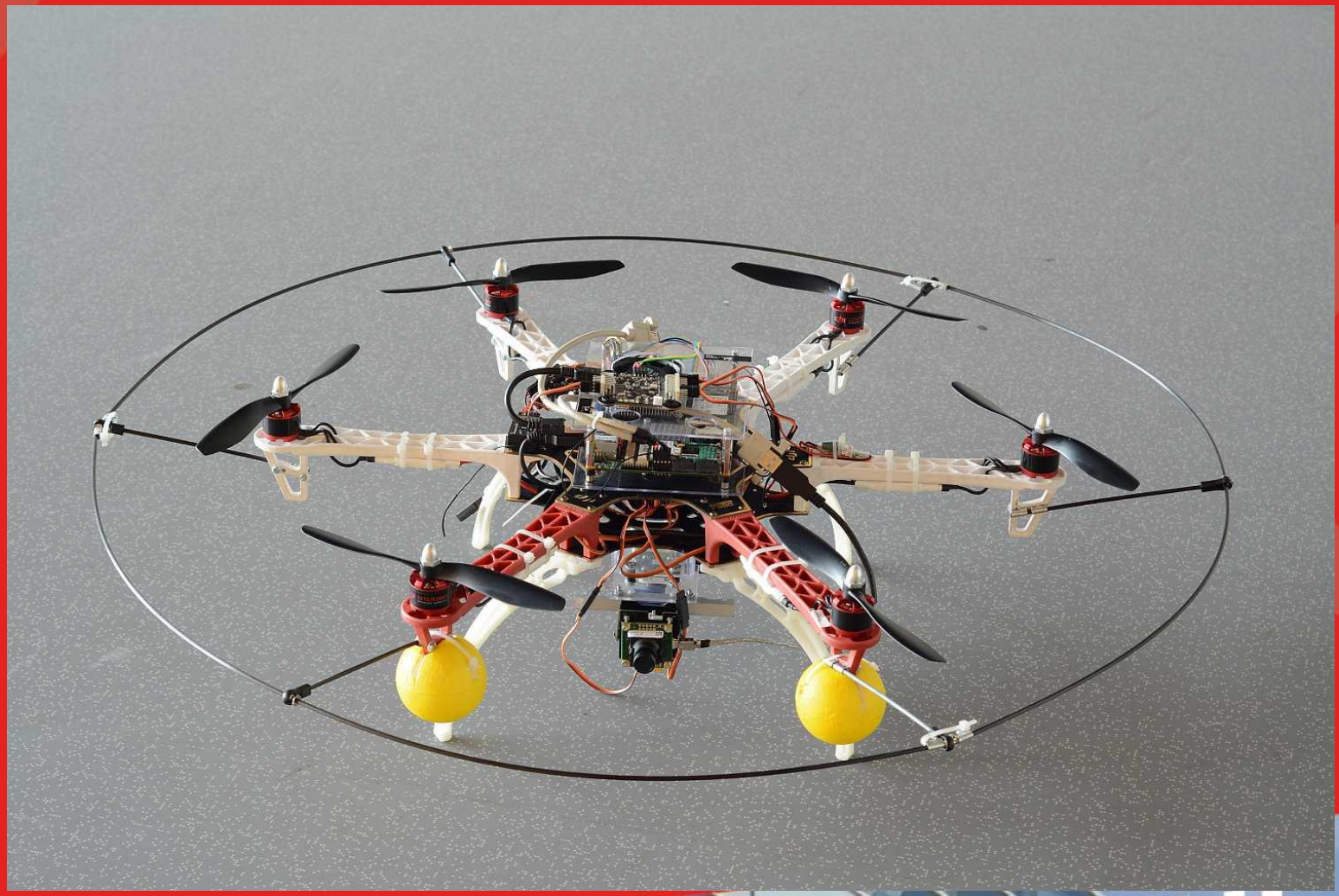
Hexa-copter



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Twirre

Architecture for autonomous mini-UAVs using interchangeable commodity components

J. van de Loosdrecht, K. Dijkstra, J.H. Postma, W. Keuning and D. Bruin
NHL University of Applied Sciences, Centre of Expertise Computer Vision (www.nhlcomputervision.nl)

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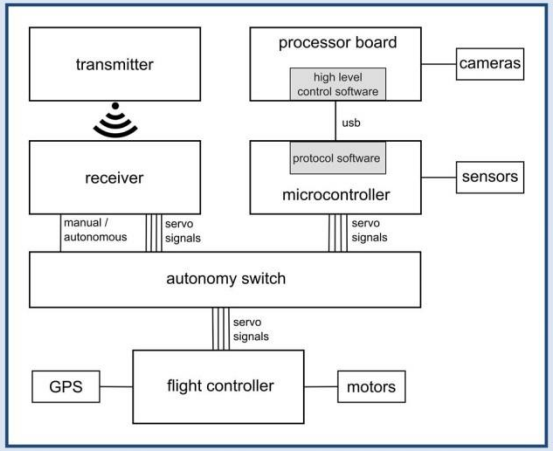
Objectives

- All sensors and processing on-board
- Low-cost components
- Upgradable and extendable
- Useful in multiple applications
- Instantly and reliably switch between manual and autonomous control

Example implementation

Architecture



Cascade control system

- High level: simulation of human stick inputs
- Low level : exchangeable flight controller

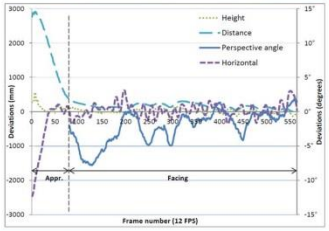
Autonomy switch

- In hardware only, no software involved

Software

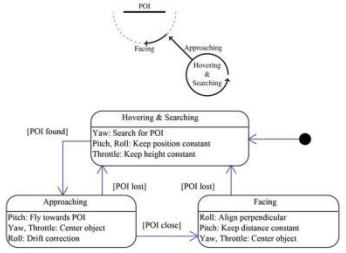
- Mission and high level control system
- Portable C(++)

Result of experiments



State machine

- Hovering & Searching
- Approaching Point of Interest
- Facing Point of Interest



Conclusions

- Twirre architecture has been derived from objectives
- Low-cost multi-copters are implemented
- Successfully tested in GPS-deprived environment
- Autonomy switch is safe and reliable

Future work

- Extract reusable software components
- Add extra sensors for increased robustness
- Extend state machine
- Release system software to public domain

International Micro Air Vehicle Conference and Competition (IMAV 2014)

Zie IMAV 2014 paper:
www.nhlcomputervision.nl

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DJI S1000+

MTOW = 11 kg
Payload = 5 kg
Flight time = 30 min

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Conclusie

The sky is the limit !?

Vragen?

Meer informatie:

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