



Stichting NIOC

Stichting NIOC en de NIOC kennisbank

Stichting NIOC (www.nioc.nl) stelt zich conform zijn statuten tot doel: het realiseren van congressen over informatica onderwijs en voorts al hetgeen met een en ander rechtstreeks of zijdelings verband houdt of daartoe bevorderlijk kan zijn, alles in de ruimste zin des woords.

De stichting NIOC neemt de archivering van de resultaten van de congressen voor zijn rekening. De website www.nioc.nl ontsluit onder "Eerdere congressen" de gearchiveerde websites van eerdere congressen. De vele afzonderlijke congresbijdragen zijn opgenomen in een kennisbank die via dezelfde website onder "NIOC kennisbank" ontsloten wordt.

Op dit moment bevat de NIOC kennisbank alle bijdragen, incl. die van het laatste congres (NIOC2025, gehouden op donderdag 27 maart 2025 jl. en georganiseerd door Hogeschool Windesheim). Bij elkaar zo'n 1500 bijdragen!

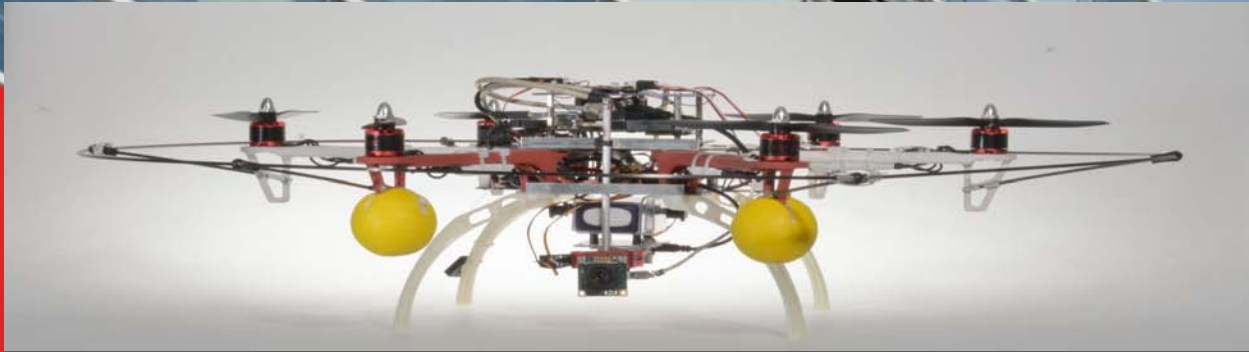
We roepen je op, na het lezen van het document dat door jou is gedownload, de auteur(s) feedback te geven. Dit kan door je te registreren als gebruiker van de NIOC kennisbank. Na registratie krijg je bericht hoe in te loggen op de NIOC kennisbank.

Het eerstvolgende NIOC vindt plaats op 18 maart 2027 in Arnhem en wordt georganiseerd door HAN University of Applied Sciences.

Reacties over de NIOC kennisbank en de inhoud daarvan kun je richten aan de beheerder:

R. Smedinga kennisbank@nioc.nl.

Vermeld bij reacties jouw naam en telefoonnummer voor nader contact.



Smart Vision for Unmanned Aerial Vehicles (UAVs)

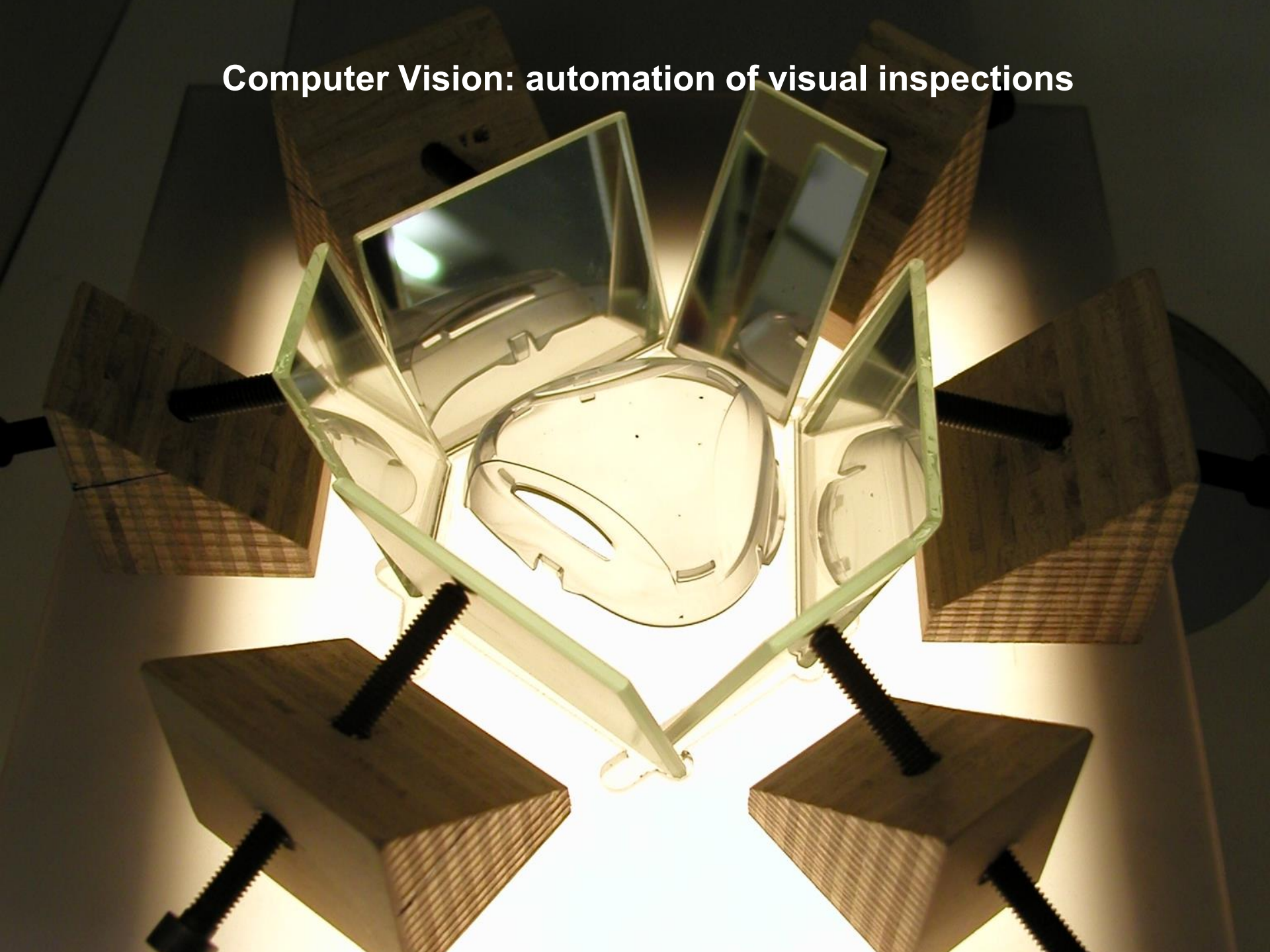
NIOC 2015, Enschede
24 April 2015

Jaap van de Loosdrecht
Lector Computer Vision
NHL Kenniscentrum Computer Vision

Overzicht

- **What is Computer Vision?**
- **NHL Centre of Expertise in Computer Vision**
- **Taxonomy Unmanned Vehicles**
- **Drones in civil applications**
- **Smart Vision for UAVs**
- **Twirre architecture for autonomous UAVs using interchangeable commodity components**
- **Future work**

Computer Vision: automation of visual inspections



Inspection of protectors for shavers



NHL Centre of Expertise in Computer Vision

- **More than 18 years THE centre of expertise in Computer Vision for Universities of applied science in the Netherlands**
- **Best practices:**
 - **More than 200 feasibility studies for the industry (> € 5.000.000,-)**
 - **Unique course material for Universities of professional education**
 - **One week course for the industry (17x)**
 - **Knowledge societies with national recognition**
 - **Cluster Computer Vision Noord Nederland (45)**
 - **Platform Beeldverwerking HBO (11)**
 - **Bridge between fundamental research of universities and the industries by performing applied research projects**

NHL Centre of Expertise in Computer Vision

Main focus:

- Computer Vision

Specialities:

- Data analysis (PCA, LDA, Neural networks, Support vector machines, Genetic algorithms, etc.)
- Acceleration algorithms using multi-core CPUs and GPUs
- Data fusion

NHL Centre of Expertise in Computer Vision

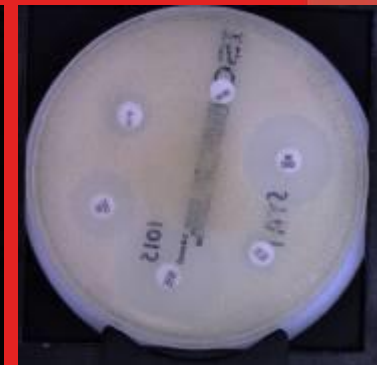
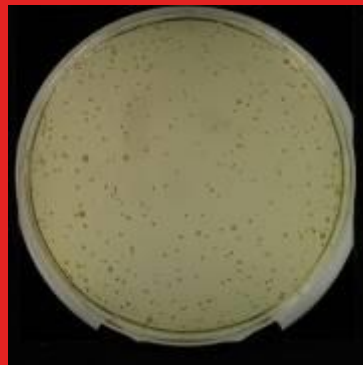
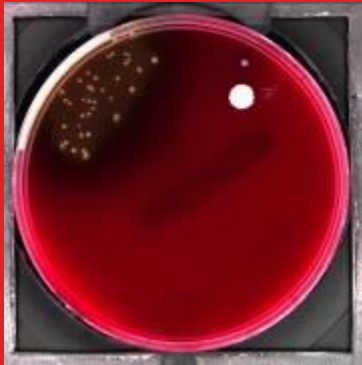
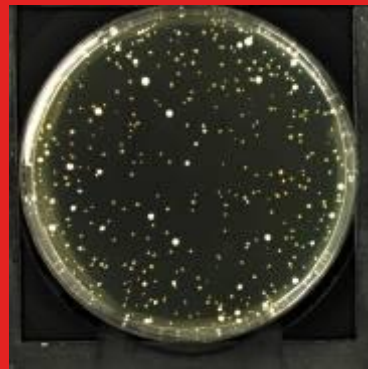
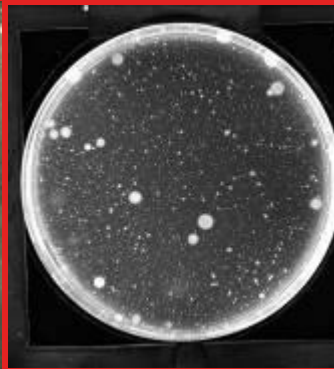
- **Established in 1996**
- **Sub division of NHL University of applied sciences, department of Engineering**
- **1 Manager (1 fte)**
- **1 Researcher (1 fte)**
- **4 Project engineers (3.5 fte)**
- **Students placement- or graduation assignment**
Total from start: 450 from the Netherlands and 45 from abroad

Equipment

The strength of the centre of expertise is knowledge and equipment for the total chain of:

- **Lighting**
- **Cameras**
(UV, VIS, NIR, SWIR, LWIR (thermographic), hyper-spectral, surround, 3D, high speed, LIDAR)
- **Optics**
- **Algorithms for image processing and data science**
- **Embedding in systems or other software**

Micro biology, petri dishes



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. Dijkstra¹, M. Berntsen², J. van de Loosdrecht¹ and W. J. Jansen¹

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.

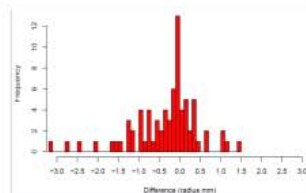
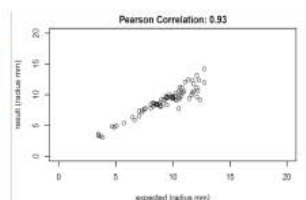
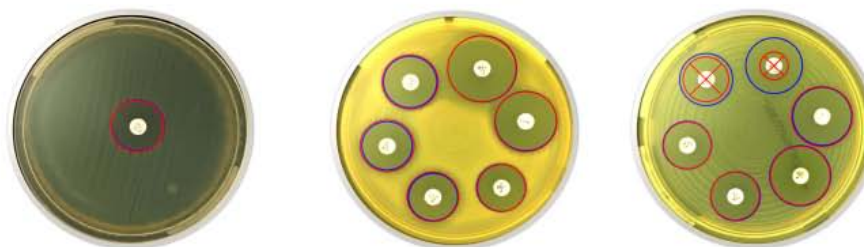
Methods

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.

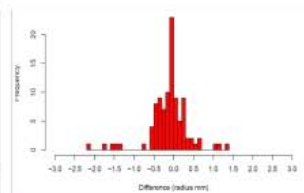
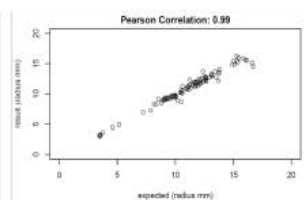
Three digital image sets of Petri-dishes using different illuminations from two European microbial laboratories have been selected from the daily routine to test the system. Evaluation is performed using a two-fold cross-validation.

Results

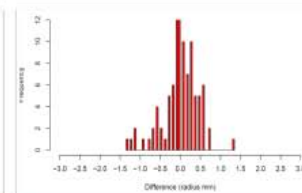
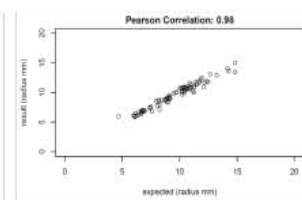
Blue and red circles are manual and automatic measurements respectively. Crossed circles are automatically rejected measurements.



Accepted: 76 of 76 zones
Correlation: 0.93



Accepted: 100 of 100 zones
Correlation: 0.99



Accepted: 96 of 152 zones
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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RESEARCH AND BUSINESS

UAV



Fixed wing



Drone



Quadrocopter



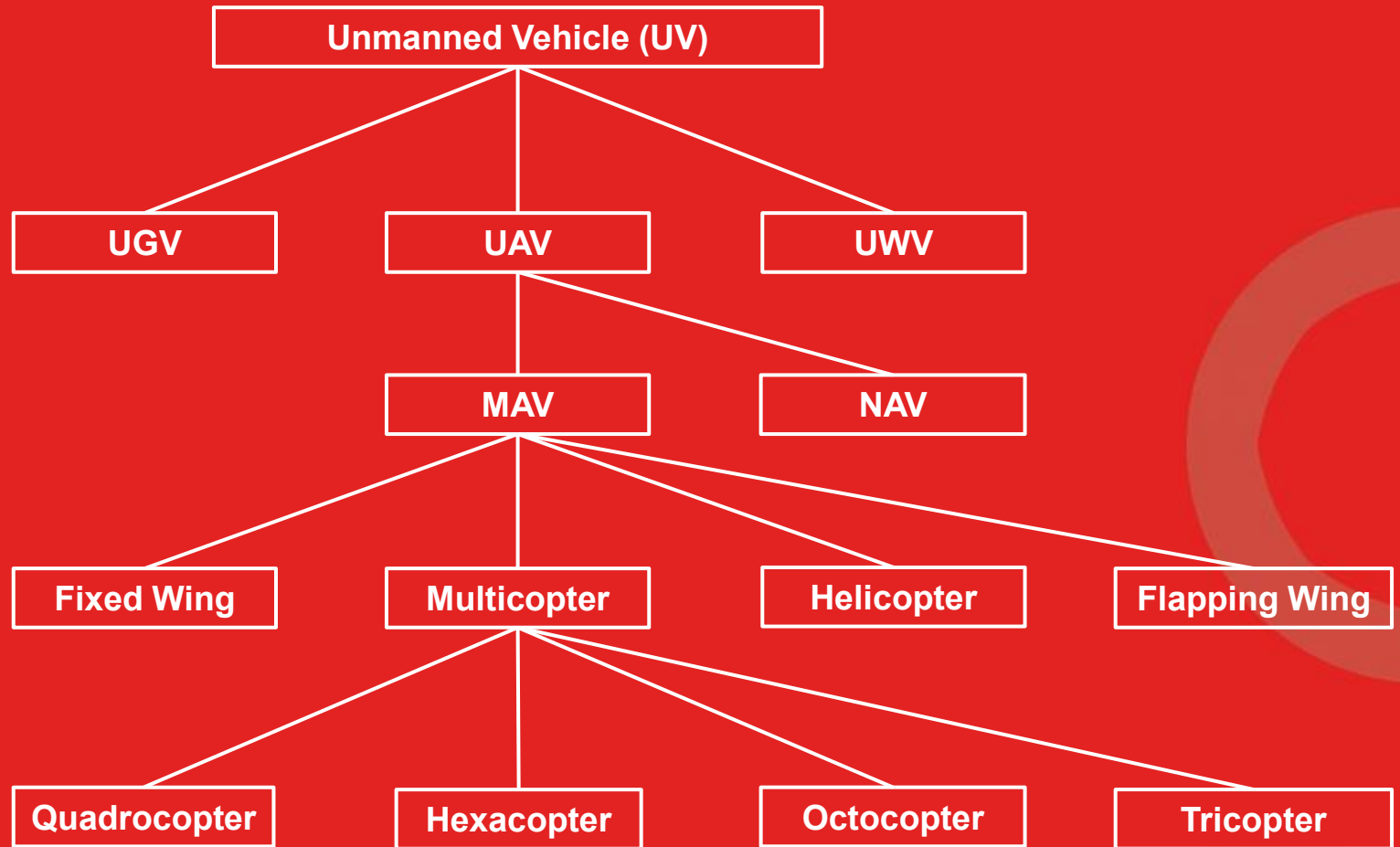
Helicopter



Hexacopter

HL
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Taxonomy of Unmanned Vehicles



Drones in civil applications with cameras

- Commercial services using drones operated by ground pilots using GPS-waypoints
- Commodity products, example: DJI Phantom



Automatic flying with GPS way-points

From GPS position to GPS position at specified height and speed

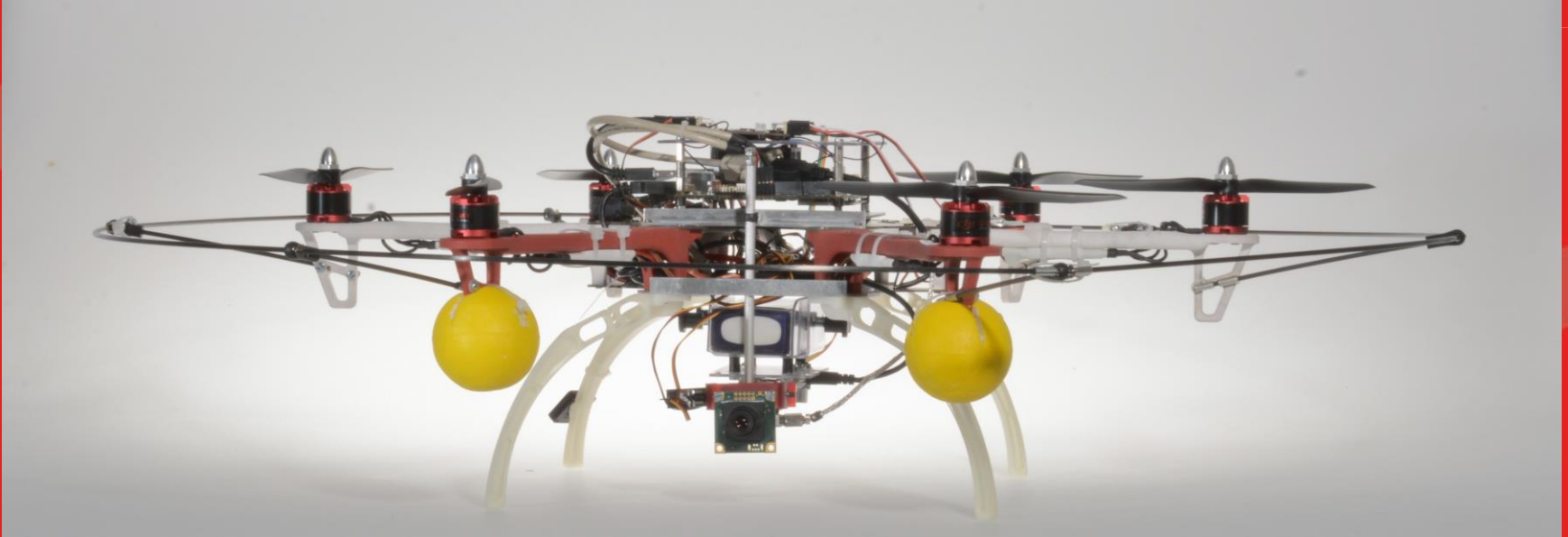


Drones in civil applications

- **Inspection wind turbine blades**
- **Inspection of agricultural fields**



Smart Visions for UAVs



- **RAAK SIA MKB project**
- **September 2014 – September 2016**
- **15 companies and institutions**
- **Business opportunities:**
 - **Wind turbine blade inspection**
 - **Detection and inspection of fires**
 - **Inspection of agricultural fields**
 - **Inspection of ditch cleaning**



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Smart Vision for UAVs

Research questions:

- Can UAVs be applied to acquire images with the required quality for the specified inspections?
- Can the inspections of those images be automated?
- Can the flying process be aided and/or automated?
- Is it possible to comply with the legislation for professional usage of UAVs?

Smart Vision for UAVs

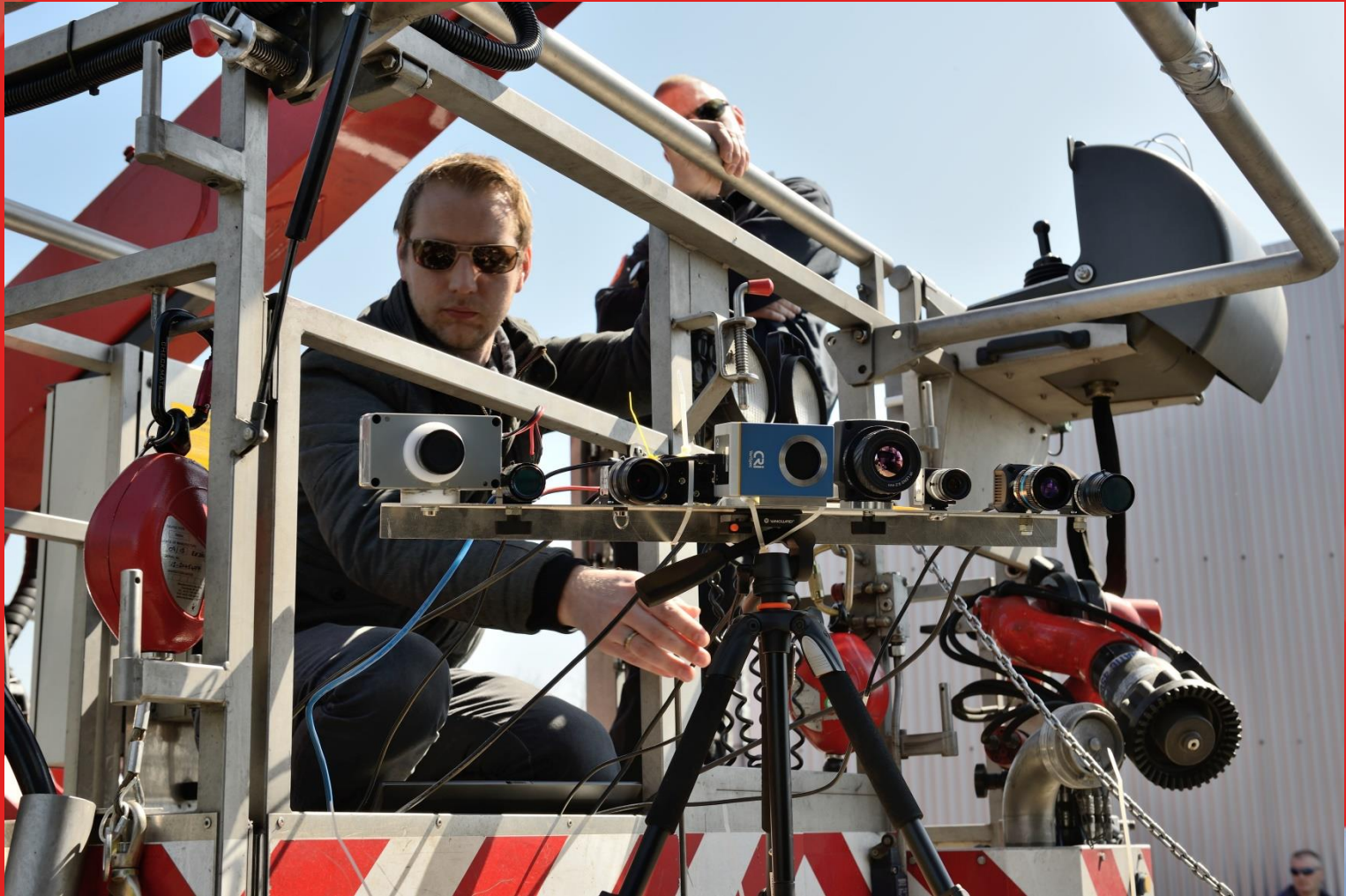
Points on the horizon:

- **A higher accuracy of position location than now is possible with standard GPS and maps**
- **Autonomous flying of missions under supervision of ground pilot who only has to intervene in case of emergencies**
- **Automatic (real-time) processing of image data to process or business support information**

Smart Vision for UAVs

Four Business Opportunities:		Research question	Research question	Research question	Research question
1. Wind turbine blade inspection	Service DroneView	Droneview NHL	NHL RacePlan IDI Snowmobile	Droneview NHL Avans Tryage	NLR (NHL)
2. Detection and inspection of fires	ITS BON	Droneview NHL	NHL IDI Snowmobile Spacemetric	Droneview NHL Tryage	
3. Inspection of agricultural fields	HLB Ana Vita Dacom	Dutch Drone Company NHL	NHL NLR Spacemetric RacePlan	Dutch Drone Company NHL Avans Tryage	
4. Inspection of ditch cleaning	HiView Wetterskip	HiView NHL	NHL Spacemetric IDI Snowmobile	HiView NHL Tryage	
Research question =>		Image acquisition	Automation of image inspection	Automation of flying process	Legislation

Test Brandweer Oefencentrum Noord (Wijster)



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Twirre architecture for autonomous UAVs using interchangeable commodity components



Starting points

- On board intelligence
- No development of hardware, UAVs and flight controllers
- No development of software flight controllers
- Standard components
 - Low cost
 - Exchangeable
 - Upgradeable
- Reliable switch between manual and autonomous operation

Automatic flying with GPS way-points

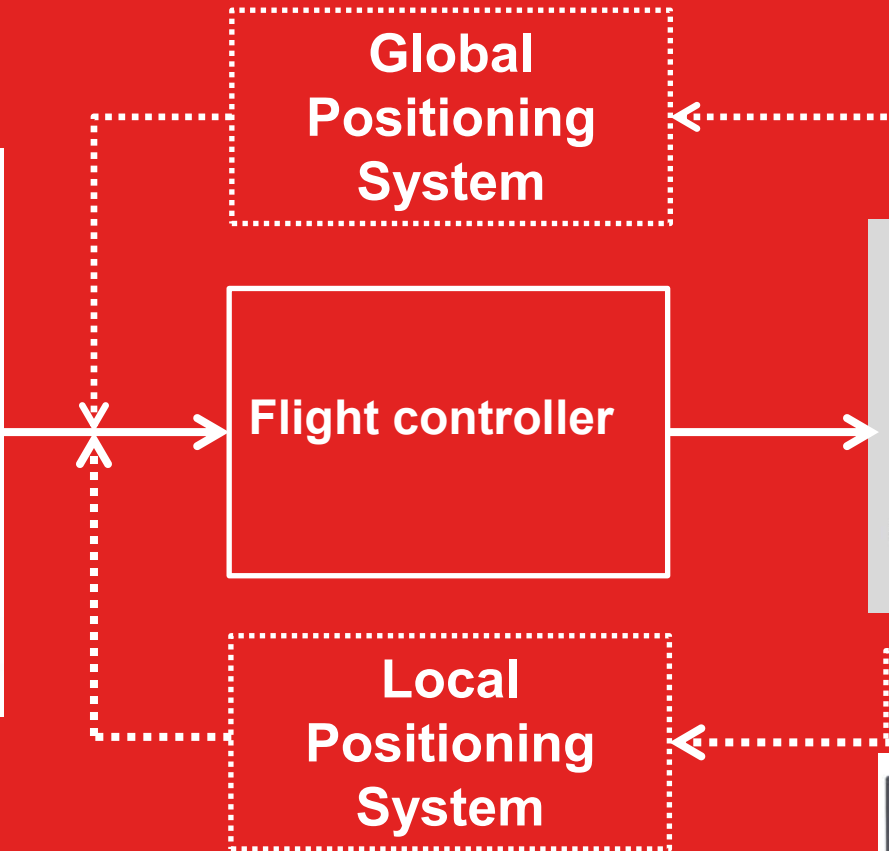


Global
Positioning
System

Flight controller

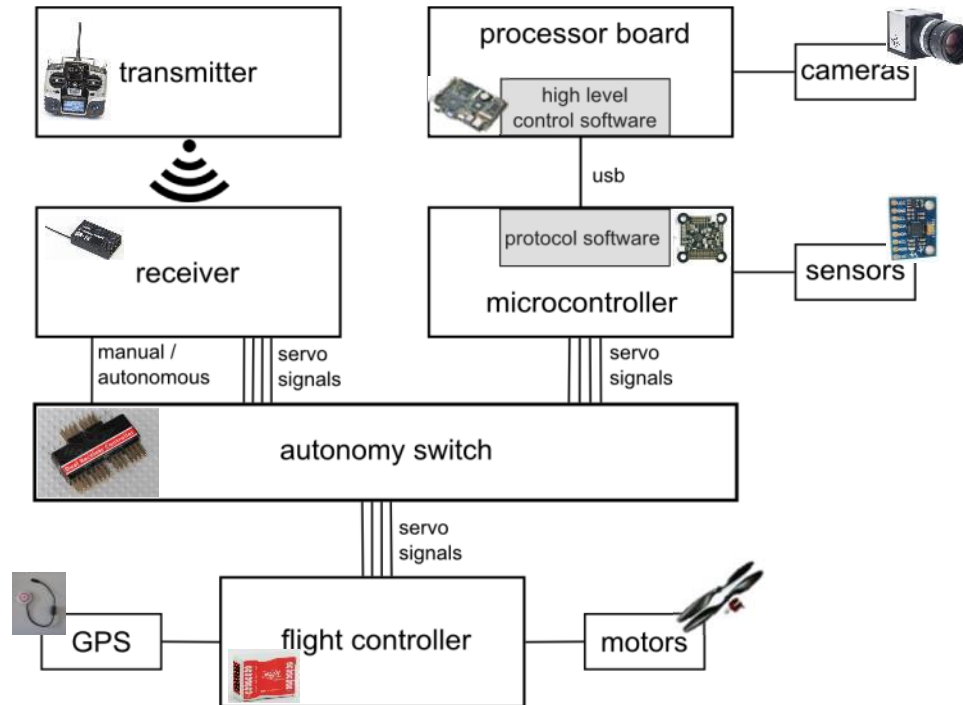


NHL Twirre architecture



sensors

Twirre architectuur



**Autonomous and
Manual control
pipelines**

**GPS-enabled and
GPS deprived flight**

Cascade control system
Low level = flight controller
High level = Simulates stick
input from human pilot

Twirre architecture

Cascade control system:

- Low level = flight controller
- High level
 - Simulates stick input from human pilot
 - Implemented in Twirre and runs on processor board
- Building high level control system is (much) easier than low level
- Changing/updating to new/better flight controller is easy

Hexa-copter



Hexa-copter (indoor)

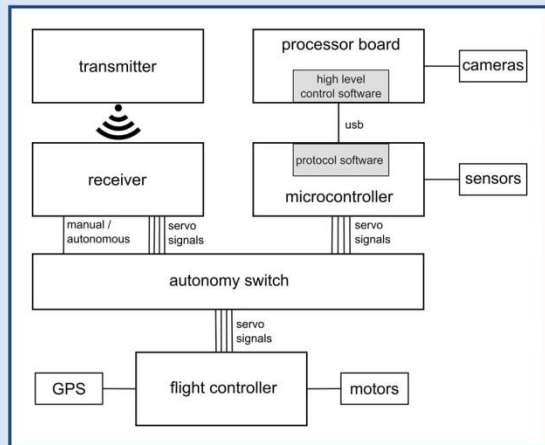


J. van de Loosdrecht, K. Dijkstra, J.H. Postma, W. Keuning and D. Bruin
NHL University of Applied Sciences, Centre of Expertise Computer Vision (www.nhlcomputervision.nl)

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

Architecture



Cascade control system

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

Autonomy switch

- In hardware only, no software involved

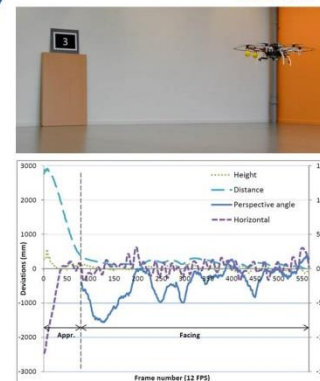
Software

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

Example implementation

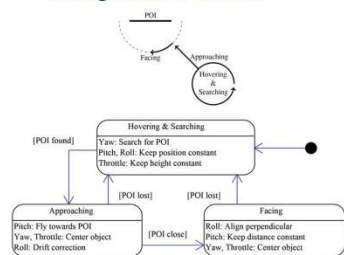


Result of experiments



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)

See for IMAV 2014 paper:
www.nhlcomputervision.nl

DJI S1000+



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

Future work on Twirre

- **Combining with other sensors like**
 - **RTK GPS**
 - **LIDAR**
 - **3D cameras**
- **32-bits Arduino**
- **Design and build generic building blocks for missions**
- **Integrating with commercial UAVs**

Questions ?

For more information:

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