Smart Tooling

Stuurgroep bijeenkomst
Update overleg 10-04-2018

Cluster : inspectie van vaten

Interreg
EUROPESE UNIE
Vlaanderen-Nederland
Europees Fonds voor Regionale Ontwikkeling

KIC|MPI
Kennis- en innovatiecentrum
Maintenance Procesindustrie

10 april 2017

Smart Tooling Inspection & Cleaning (P. de Boevere BV)

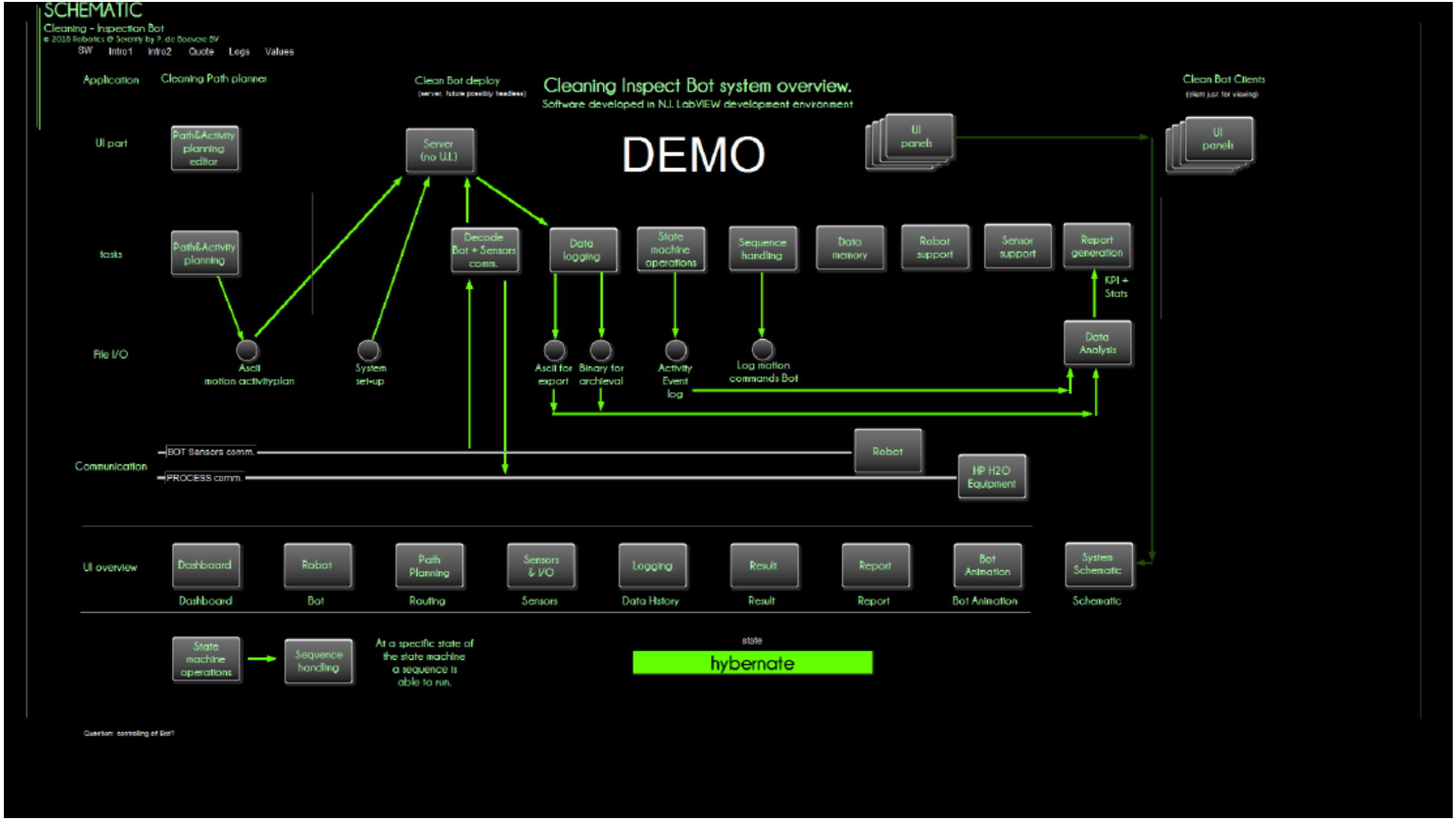
Inleiding:

Projecten gecombineerd

Twee producten:

Plan-fase: **Configurator**

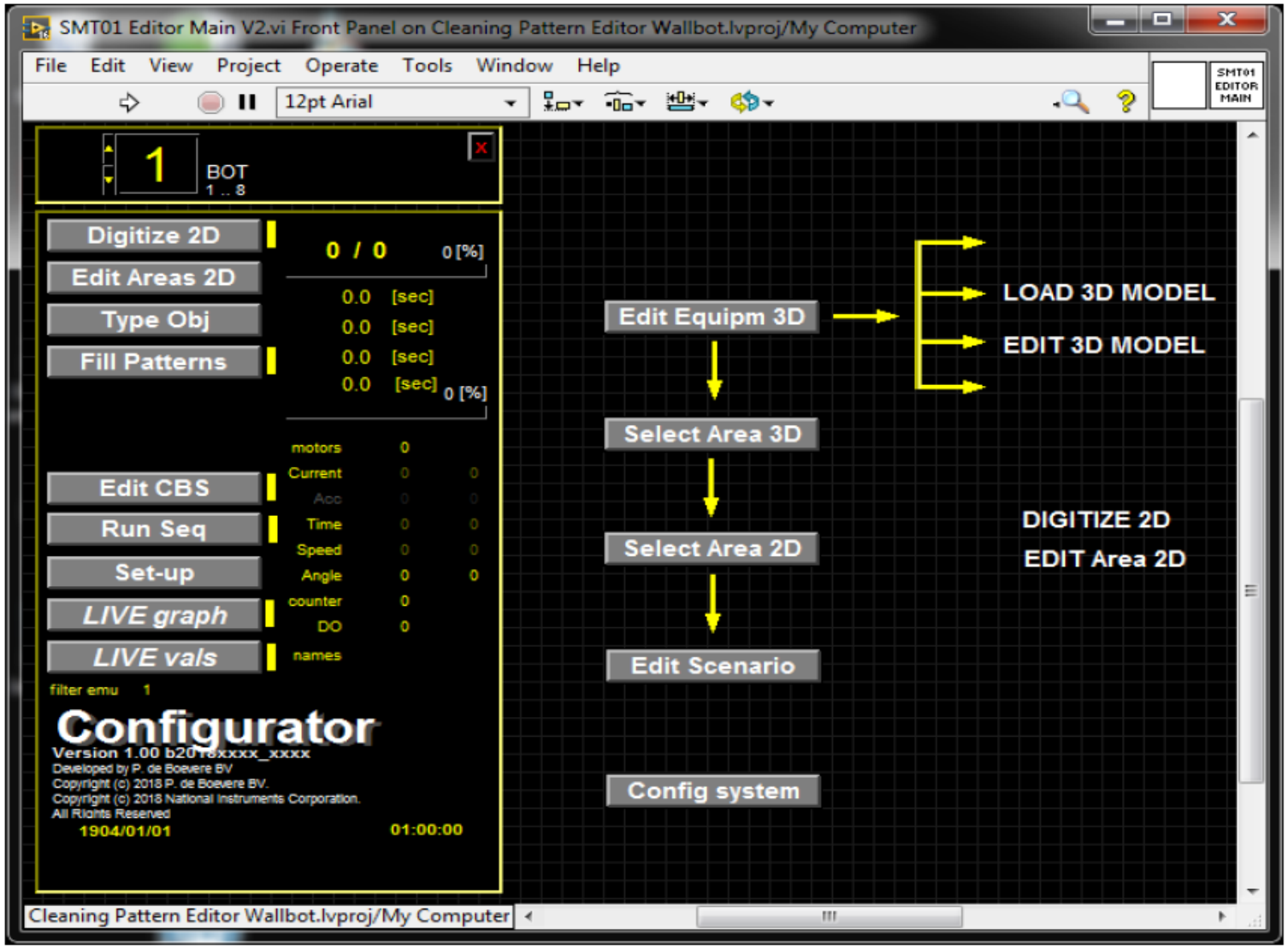
Uitvoering: **Dashboard**

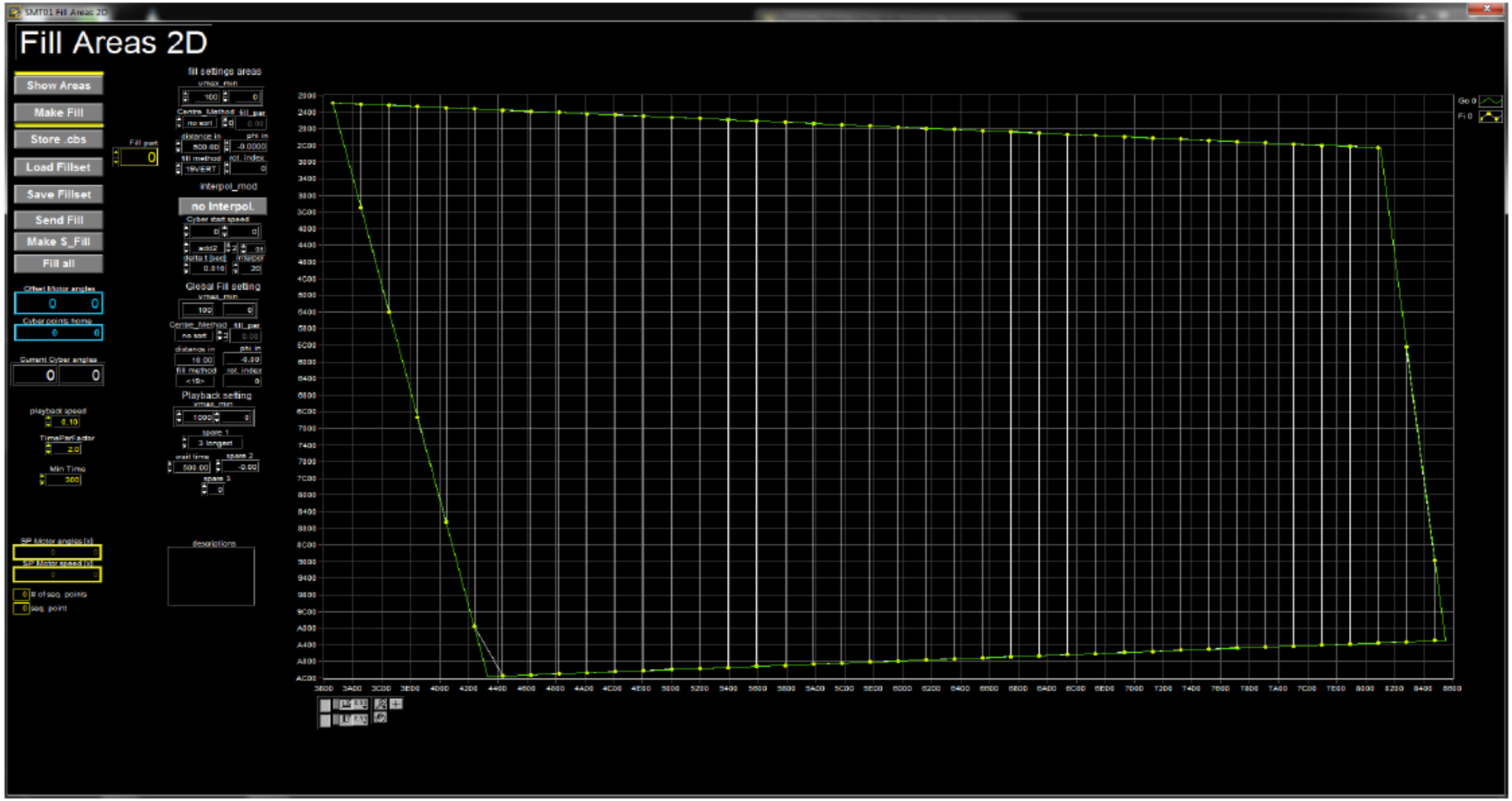

SCHEMATIC
Cleaning - Inspection Bot
© 2018 Robotics © Sweeny by P. de Boevere BV
SW Intro1 Intro2 Quote Logs Values
Application
Cleaning Path planner
Clean Bot deploy
(server, future possibly headless)
Cleaning Inspect Bot system overview.
Software developed in N.I. LabVIEW development environment
DEMO
Clean Bot Clients
(client just for viewing)
UI part
Path&Activity planning editor
Server (no U.I.)
UI panels
UI panels
tasks
Path&Activity planning
Decode Bot + Sensors comm.
Data logging
State machine operations
Sequence handling
Data memory
Robot support
Sensor support
Report generation
KPI + Stats
File I/O
Ascii motion activityplan
System set-up
Ascii for export
Binary for archieval
Activity Event log
Log motion commands Bot
Data Analysis
Communication
BOT Sensors comm.
PROCESS comm.
Robot
HP H2O Equipment
UI overview
Dashboard
Robot
Path Planning
Sensors & I/O
Logging
Result
Report
Bot Animation
System Schematic
Dashboard
Bot
Routing
Sensors
Data History
Result
Report
Bot Animation
Schematic
State machine operations
Sequence handling
At a specific state of the state machine a sequence is able to run.
state
hybernate
Question: controlling of Bot?

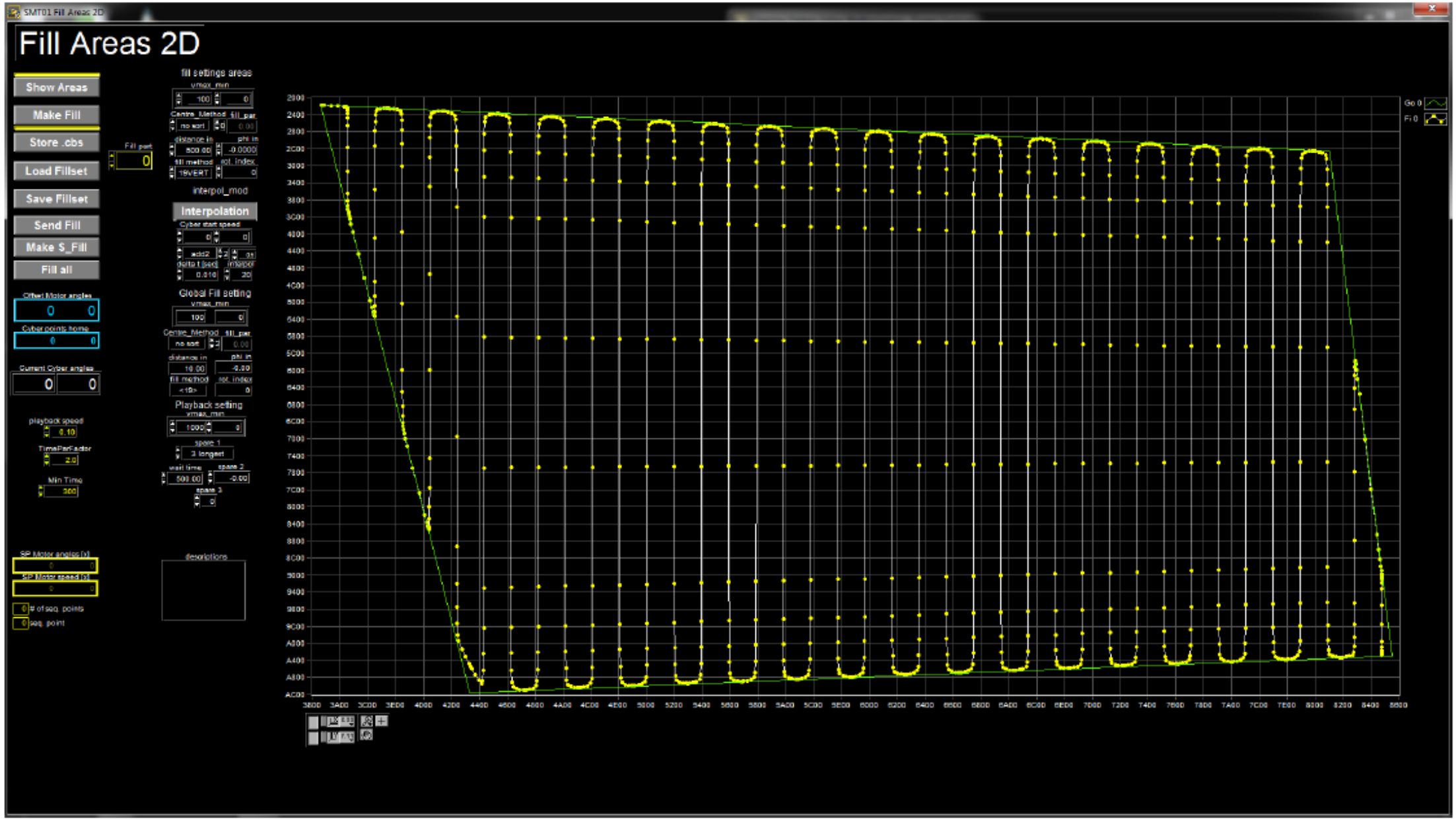
Configurator Plan en voorbereidings-fase (35% compleet)

Doel:
– Plan exact wat er moet gebeuren
– No surprises

Stappen:
– Digitizing 3D → 2D
– Selectie van de gebieden en de no-go area
– Berekening bewegingspatronen


SMT01 Editor Main V2.vi Front Panel on Cleaning Pattern Editor Wallbot.lvproj/My Computer
File Edit View Project Operate Tools Window Help
12pt Arial
SMT01 EDITOR MAIN
1
BOT
1 .. 8
Digitize 2D
Edit Areas 2D
Type Obj
Fill Patterns
Edit CBS
Run Seq
Set-up
LIVE graph
LIVE vals
0 / 0
0 [%]
0.0 [sec]
0.0 [sec]
0.0 [sec]
0.0 [sec]
0 [%]
motors 0
Current 0 0
Acc 0 0
Time 0 0
Speed 0 0
Angle 0 0
counter 0
DO 0
names
filter emu 1
Configurator
Version 1.00 b20 18xxxx_xxxx
Developed by P. de Boevere BV
Copyright (c) 2018 P. de Boevere BV.
Copyright (c) 2018 National Instruments Corporation.
All Rights Reserved
1904/01/01
01:00:00
Edit Equipm 3D
LOAD 3D MODEL
EDIT 3D MODEL
Select Area 3D
Select Area 2D
DIGITIZE 2D
EDIT Area 2D
Edit Scenario
Config system
Cleaning Pattern Editor Wallbot.lvproj/My Computer


SMT01 Fill Areas 2D
Fill Areas 2D
Show Areas
Make Fill
Store .cbs
Load Fillset
Save Fillset
Send Fill
Make S_Fill
Fill all
Fill part
0
fill settings areas
vmax_min
Centre_Method
fill_par
distance in
phi in
fill method
rot. index
interpol_mod
no interpol.
Cyber start speed
Global Fill setting
Playback setting
spare 1
3 longest
spare 2
spare 3
Offset Motor angles
Cyber points home
Current Cyber angles
playback speed
TimePerFactor
Min Time
SP Motor angles [°]
SP Motor speed [°]
# of seq. points
seq. point
descriptions
Go 0
Fi 0


SMT01 Fill Areas 2D
Fill Areas 2D
Show Areas
Make Fill
Store .cbs
Load Fillset
Save Fillset
Send Fill
Make S_Fill
Fill all
Fill part
fill settings areas
vmax_min
Centre_Method
fill_par
distance in
phi in
fill method
rot_index
interpol_mod
Interpolation
Cyber start speed
delta t [sec]
interpol
Global Fil setting
Playback setting
spare 1
3 longest
wait time
spare 2
spare 3
Offset Motor angles
Cyber points home
Current Cyber angles
playback speed
TimePerFactor
Min Time
SP Motor angles [x]
SP Motor speed [s]
# of seq. points
seq. point
descriptions
Go 0
Fi 0

Dashboard Uitvoeringsfase: (50% compleet)

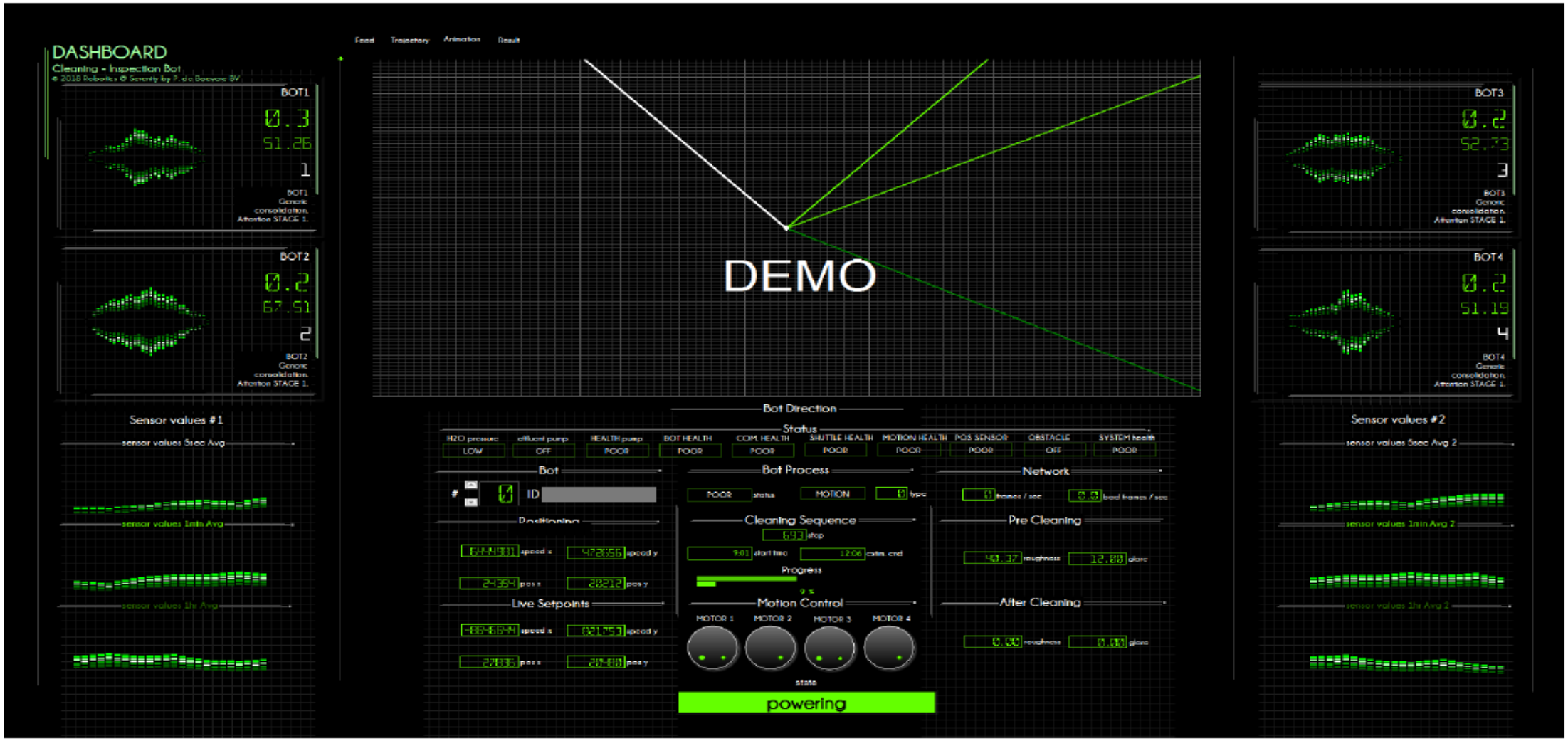
Doel:
Zonder visueel beeld navigeren en controleren.

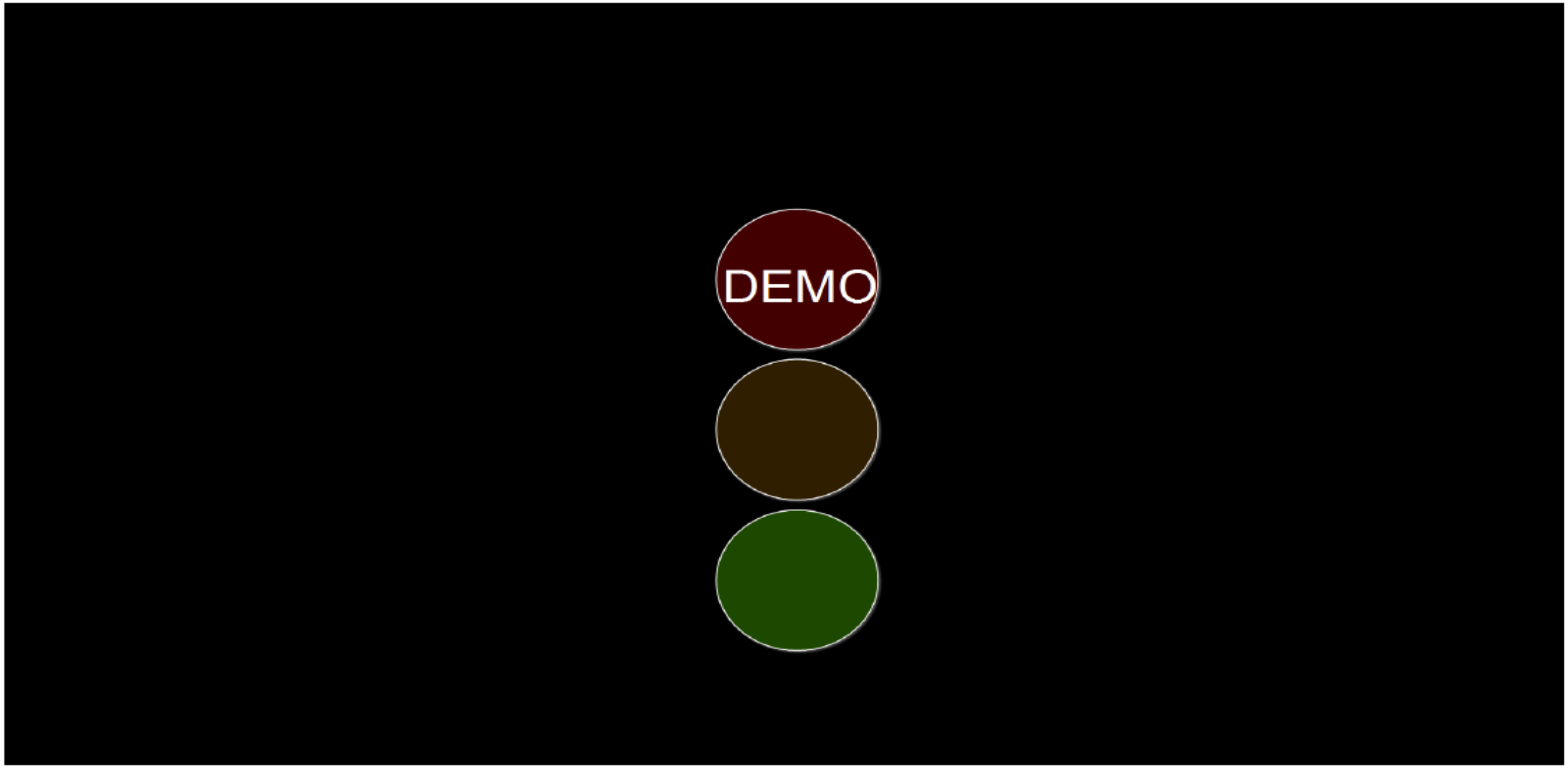
Hoe?
Instrumenten op schermen (Na 100 jaar blind vliegen in vliegtuigen)

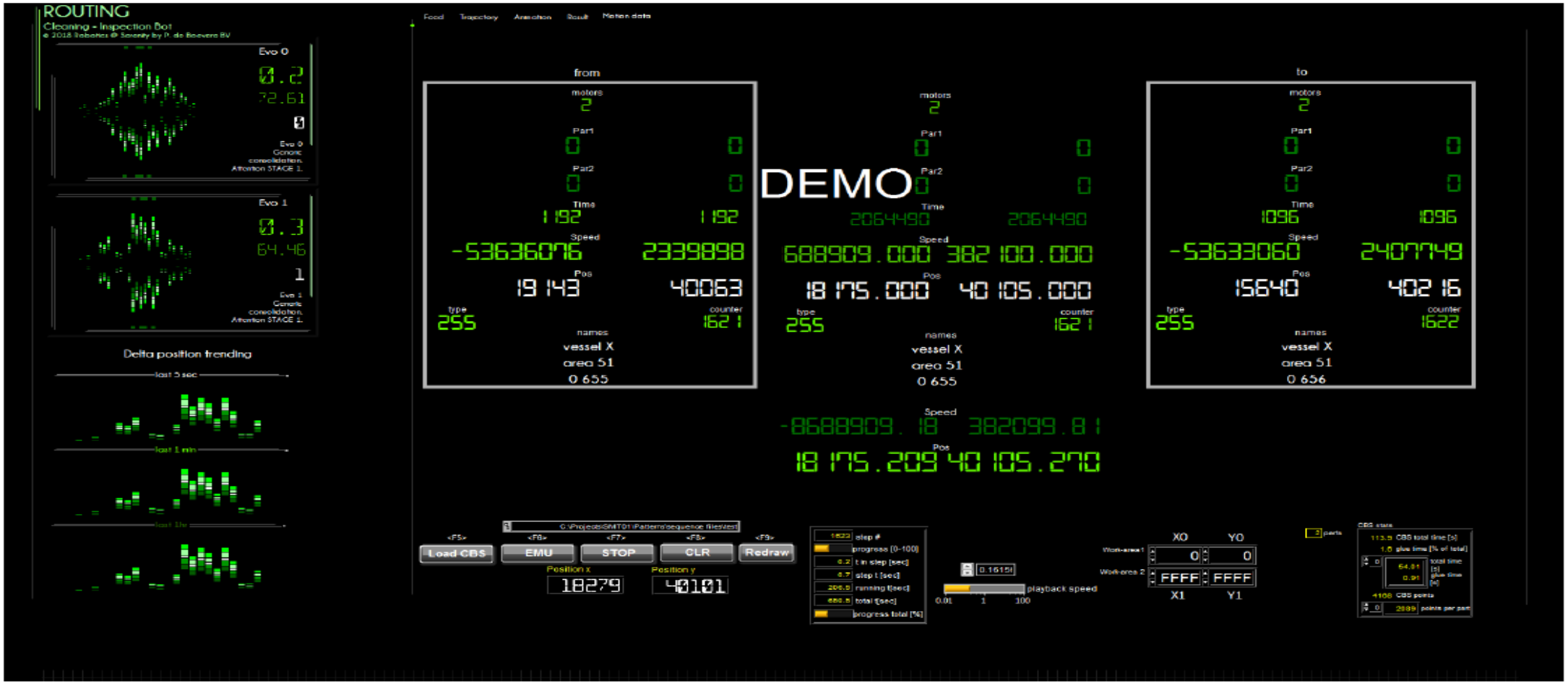
Achtergrond-processen:
- **Datalogging**
- **Status-controle**
- **Resultaten berekenen**
- **Rapportage**
- **? Alarmering**

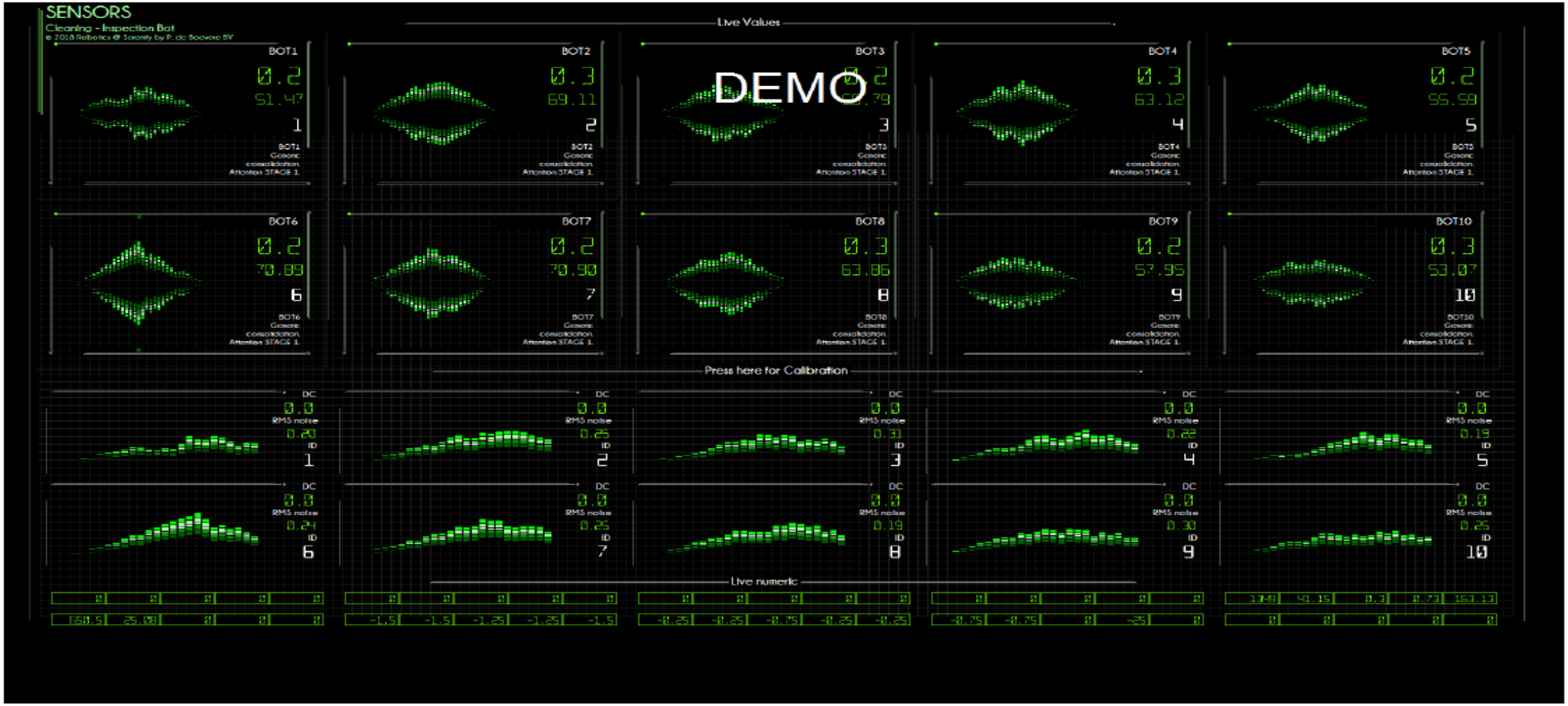
Clean Inspection BOT system

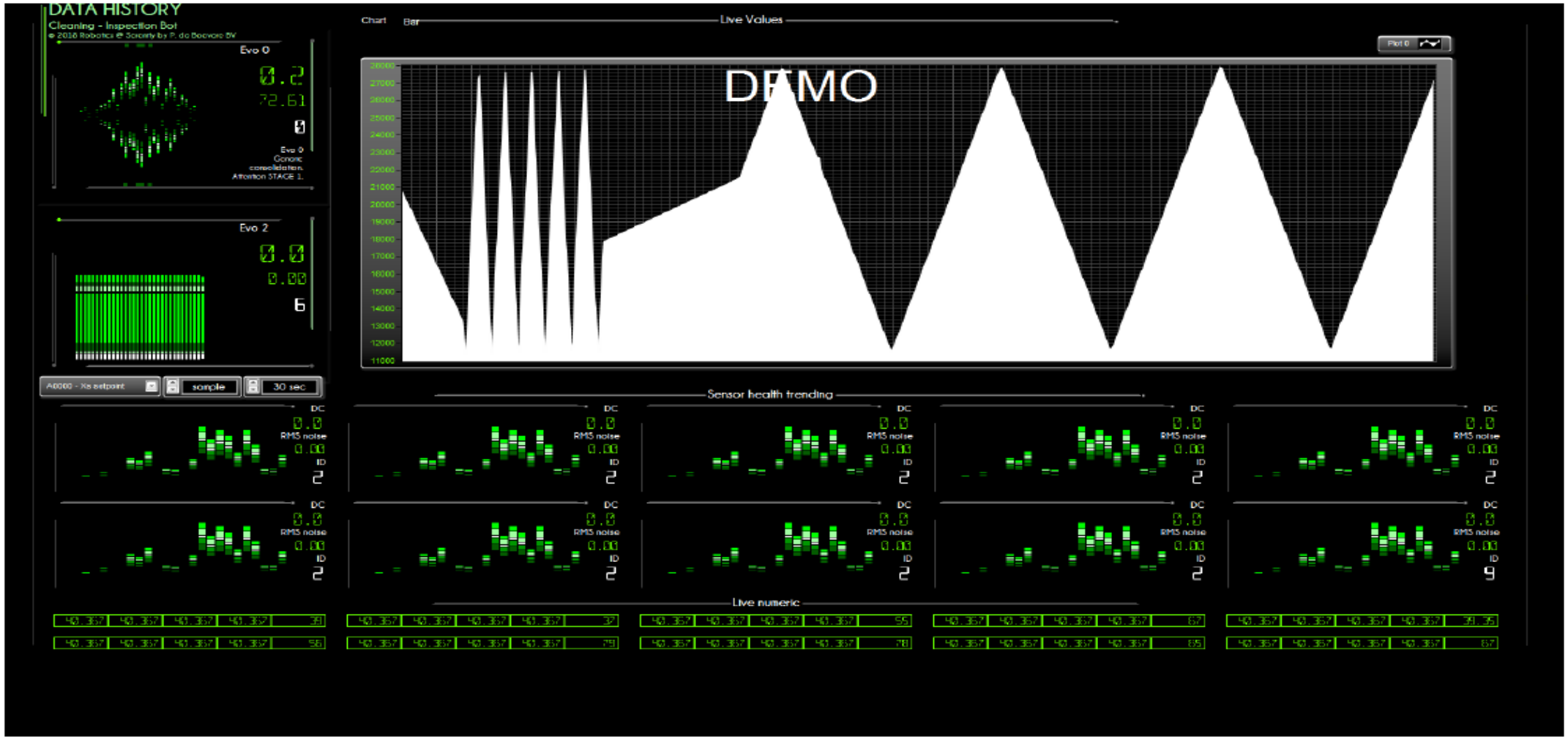
Getting ready to deploy _ _ _


DASHBOARD
Cleaning - Inspection Bot
Feed
Trajectory
Animation
Result
BOT1
0.3
51.26
1
BOT1 Generic consolidation. Attention STAGE 1.
BOT2
0.2
67.51
2
BOT2 Generic consolidation. Attention STAGE 1.
DEMO
BOT3
0.2
52.73
3
BOT3 Generic consolidation. Attention STAGE 1.
BOT4
0.2
51.19
4
BOT4 Generic consolidation. Attention STAGE 1.
Sensor values #1
sensor values 5sec Avg
sensor values 1min Avg
sensor values 1hr Avg
Bot Direction
Status
H2O pressure
effluent pump
HEALTH pump
BOT HEALTH
COM. HEALTH
SHUTTLE HEALTH
MOTION HEALTH
POS SENSOR
OBSTACLE
SYSTEM health
LOW
OFF
POOR
POOR
POOR
POOR
POOR
POOR
OFF
POOR
Bot
ID
Positioning
Live Setpoints
Bot Process
POOR
status
MOTION
type
Cleaning Sequence
stop
start time
calm. end
Progress
Motion Control
MOTOR 1
MOTOR 2
MOTOR 3
MOTOR 4
state
powering
Network
frames / sec
bad frames / sec
Pre Cleaning
roughness
glare
After Cleaning
roughness
glare
Sensor values #2
sensor values 5sec Avg 2
sensor values 1min Avg 2
sensor values 1hr Avg 2

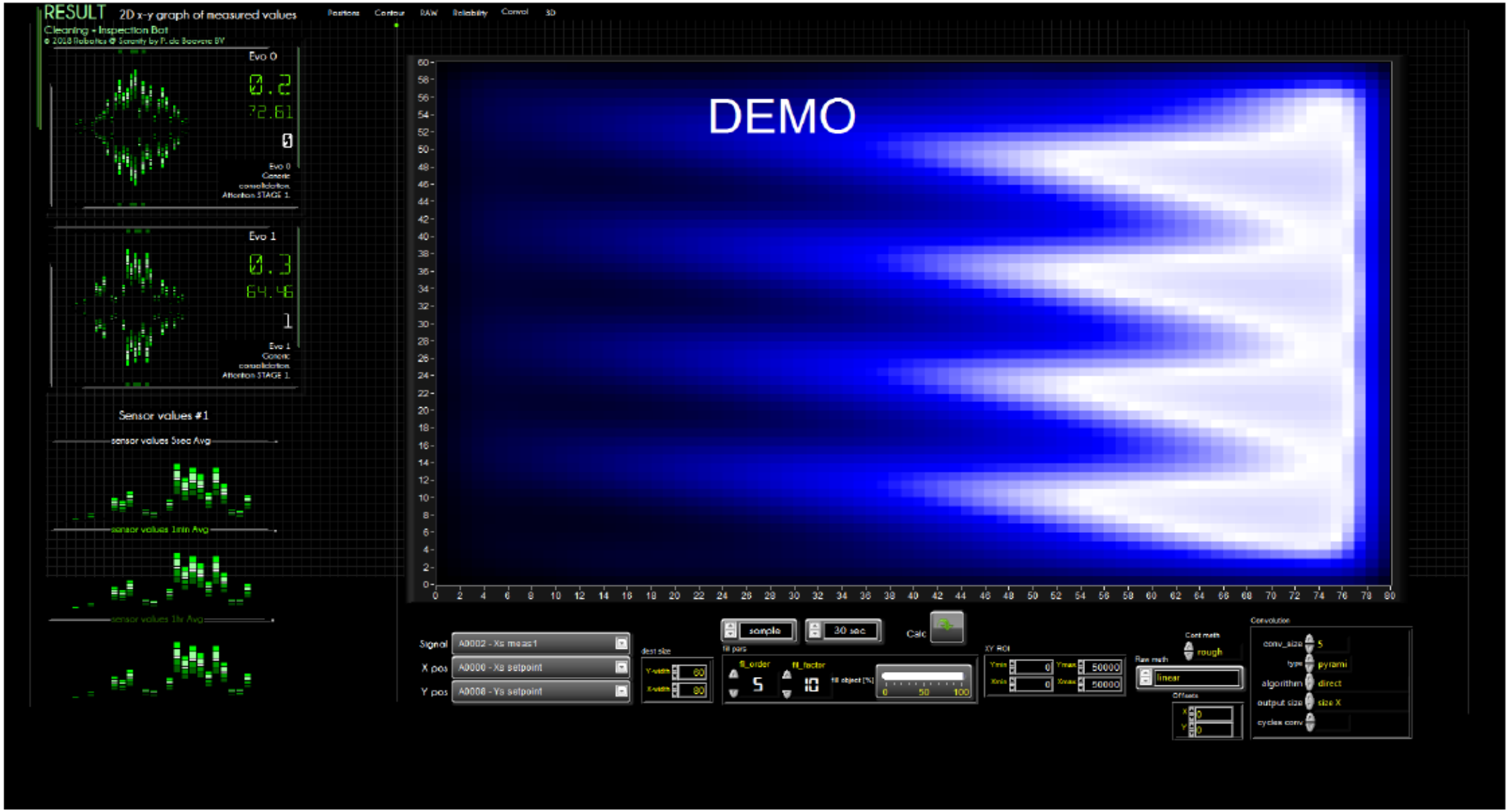

DEMO

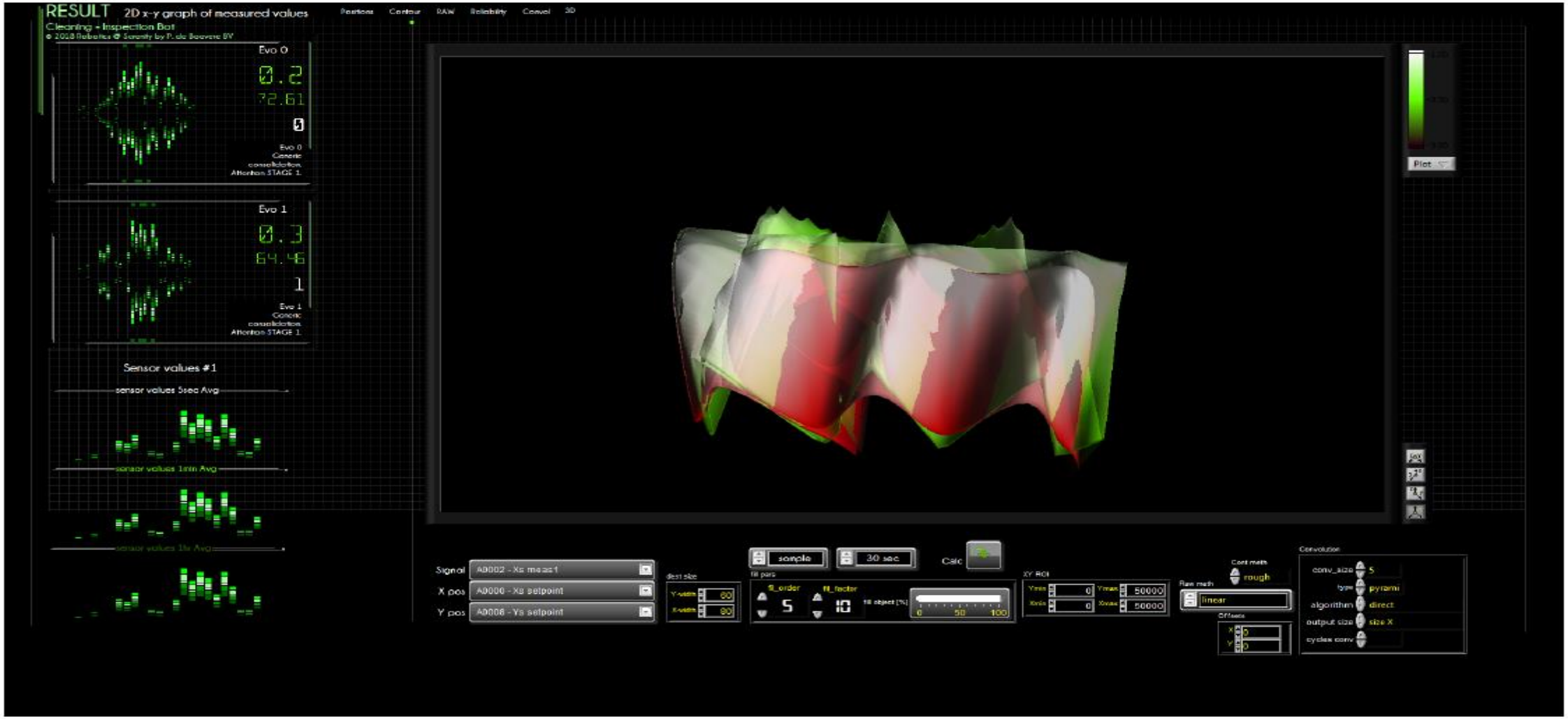

ROUTING
Cleaning - Inspection Bot
Food
Trajectory
Annotation
Result
Motion data
Evo 0
Evo 1
Delta position trending
last 5 sec
last 1 min
last 1hr
from
to
DEMO
motors
Par1
Par2
Time
Speed
Pos
type
counter
names
vessel X
area 51
0 655
0 656
Load CBS
EMU
STOP
CLR
Redraw
Position x
Position y
18279
40101
playback speed
Work-area 1
Work-area 2
X0
Y0
X1
Y1
CBS state
CBS points
points per part

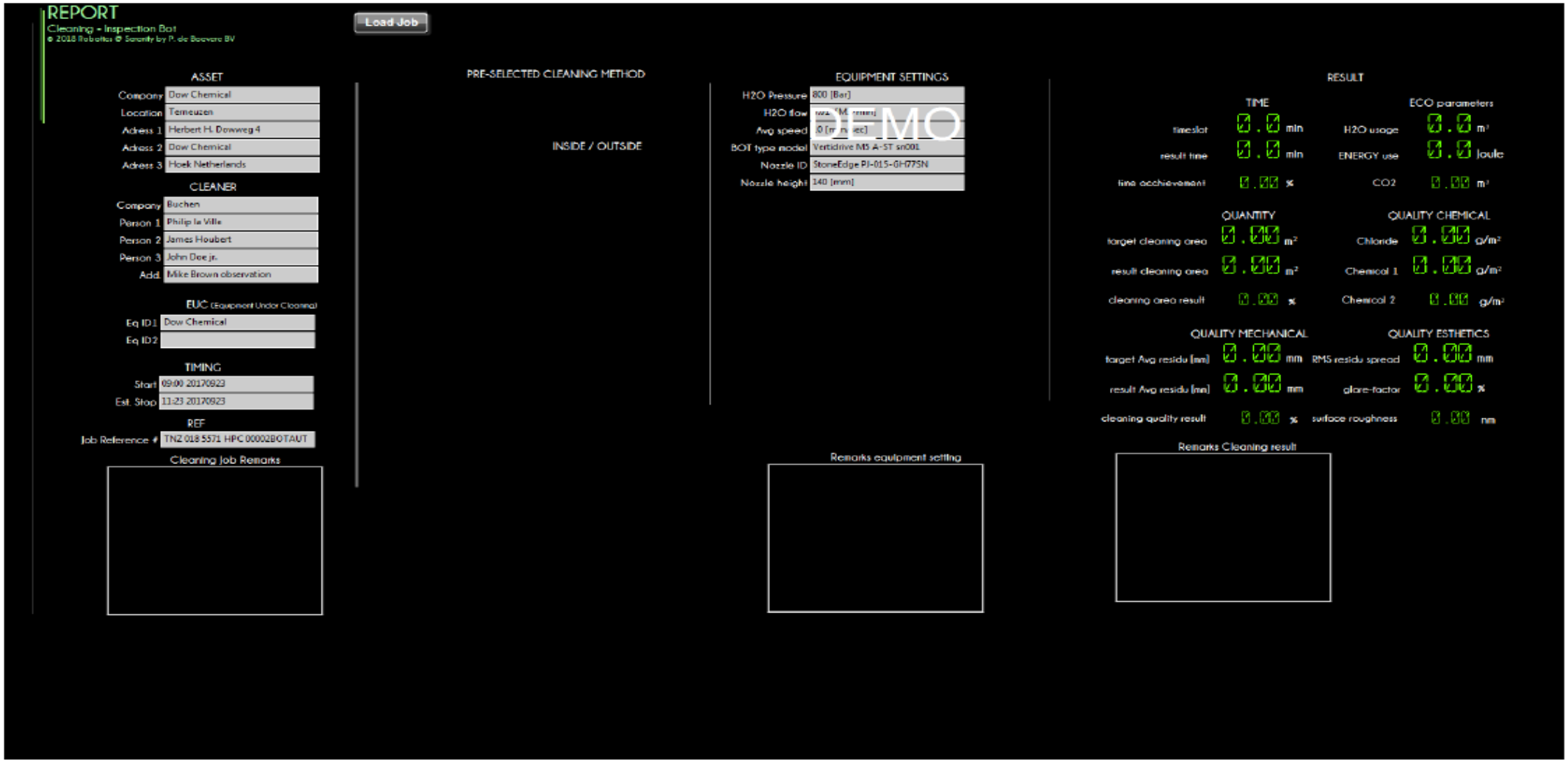

SENSORS
Cleaning - Inspection Bot
© 2018 Robotics @ Serenity by P. de Boevere BV
Live Values
DEMO
BOT1
0.2
51.47
1
BOT2
0.3
69.11
2
BOT3
0.2
3
BOT4
0.3
63.12
4
BOT5
0.2
55.58
5
BOT6
0.2
70.89
6
BOT7
0.2
70.90
7
BOT8
0.3
63.86
8
BOT9
0.2
57.95
9
BOT10
0.3
53.07
10
Generic consolidation Attention STAGE 1.
Press here for Calibration
DC
0.0
RMS noise
0.20
0.25
0.31
0.22
0.19
0.24
0.25
0.19
0.30
0.25
ID
Live numeric

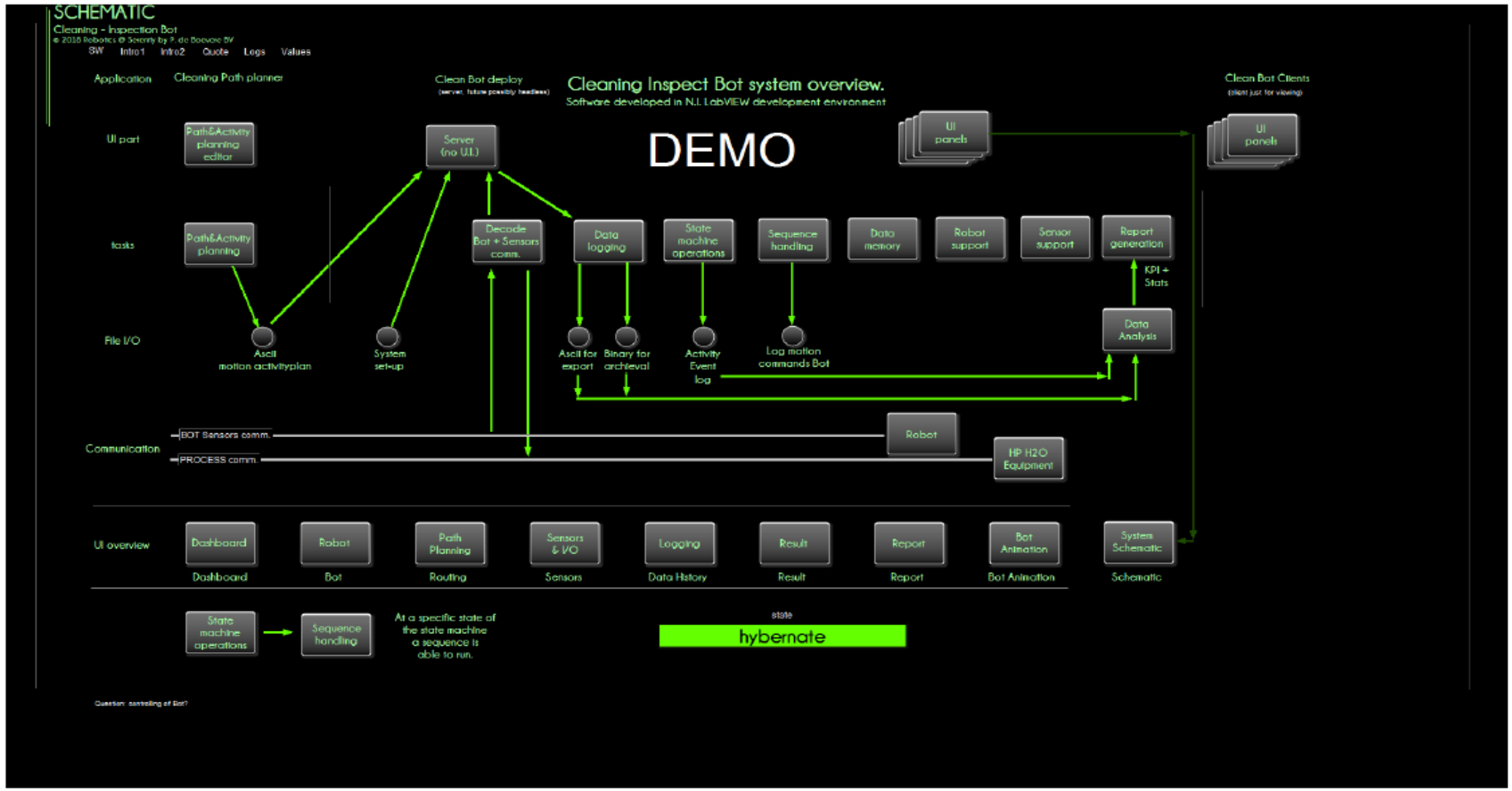

DATA HISTORY
Cleaning – Inspection Bot
© 2018 Robotics & Security by P. de Boever BV
Evo 0
0.2
72.61
0
Evo 0
Corona
consolidation
Attention STAGE 1.
Evo 2
0.0
0.00
6
A0000 - Xs setpoint
sample
30 sec
Chart
Bar
Live Values
Plot 0
DEMO
Sensor health trending
DC
0.0
RMS noise
0.00
ID
2
Live numeric


RESULT
2D x-y graph of measured values
Cleaning + Inspection Bot
Positions
Contour
RAW
Reliability
Convol
3D
trail
Recent
Current Pos
setpoint
DEMO
Evo 0
0.2
72.61
0
Evo 1
0.3
64.46
1
Sensor values #1
sensor values 5sec Avg
sensor values 1min Avg
sensor values 1hr Avg
Signal
A0002 - Xs meas1
X pos
A0000 - Xs setpoint
Y pos
A0006 - Ys setpoint
sample
30 sec
Calc
fil_order
5
fil_factor
10
XY ROI
Cont meth
rough
Raw meth
linear
Convolution
conv_size
5
type
pyrami
algorithm
direct
output size
size X
cyclex conv


RESULT
2D x-y graph of measured values
Cleaning + Inspection Bot
© 2018 Robotics @ Scrunity by P. de Baerdemaeker BV
Positions
Contour
RAW
Reliability
Control
3D
Evo 0
0.2
72.61
Evo 0
Generic
consolidation
Attention STAGE 1
Evo 1
0.3
64.46
1
Evo 1
Generic
consolidation
Attention STAGE 1
Sensor values #1
sensor values 5sec Avg
sensor values 1min Avg
sensor values 1hr Avg
DEMO
Signal
A0002 - Xs meas1
X pos
A0000 - Xs setpoint
Y pos
A0006 - Ys setpoint
dest size
Y-width
80
X-width
80
sample
30 sec
Calc
fit pars
fit_order
5
fit_factor
10
fit object [%]
0
50
100
XY ROI
Ymin
0
Ymax
50000
Xmin
0
Xmax
50000
Cont meth
rough
Raw meth
linear
Offsets
X
0
Y
0
Convolution
conv_size
5
type
pyrami
algorithm
direct
output size
size X
cyclex conv


RESULT
2D x-y graph of measured values
Cleaning + Inspection Bot
Positions
Contour
RAW
Reliability
Convol
3D
Evo 0
0.2
72.61
0
Evo 1
0.3
64.46
1
Sensor values #1
sensor values 5sec Avg
sensor values 1min Avg
Plot
Signal
A0002 - Xs meas1
X pos
A0000 - Xs setpoint
Y pos
A0008 - Ys setpoint
sample
30 sec
Calc
fit_order
fit_factor
Cont meth
rough
Raw meth
linear
Convolution
conv_size
type
pyrami
algorithm
direct
output size
size X
cycles conv


REPORT
Cleaning + Inspection Bot
© 2018 Robotics © Serenity by P. de Beevere BV
Load Job
ASSET
Company Dow Chemical
Location Terneuzen
Adress 1 Herbert H. Dowweg 4
Adress 2 Dow Chemical
Adress 3 Hoek Netherlands
CLEANER
Company Buchen
Person 1 Philip le Ville
Person 2 James Houbert
Person 3 John Doe jr.
Add Mike Brown observation
EUC (Equipment Under Cleaning)
Eq ID 1 Dow Chemical
Eq ID 2
TIMING
Start 09:00 20170923
Est. Stop 11:23 20170923
REF
Job Reference # TNZ 018 5571 HPC 00002BOTAUT
Cleaning Job Remarks
PRE-SELECTED CLEANING METHOD
INSIDE / OUTSIDE
EQUIPMENT SETTINGS
H2O Pressure 800 [Bar]
H2O flow
Avg speed 0 [m/sec]
BOT type model Vertidrive M5 A-ST sn001
Nozzle ID StoneEdge PJ-015-GH77SN
Nozzle height 140 [mm]
DEMO
Remarks equipment setting
RESULT
TIME
timeslot 0.0 min
result time 0.0 min
time achievement 0.00 %
ECO parameters
H2O usage 0.0 m³
ENERGY use 0.0 Joule
CO2 0.00 m³
QUANTITY
target cleaning area 0.00 m²
result cleaning area 0.00 m²
cleaning area result 0.00 %
QUALITY CHEMICAL
Chloride 0.00 g/m²
Chemical 1 0.00 g/m²
Chemical 2 0.00 g/m²
QUALITY MECHANICAL
target Avg residu [mm] 0.00 mm
result Avg residu [mm] 0.00 mm
cleaning quality result 0.00 %
QUALITY ESTHETICS
RMS residu spread 0.00 mm
glare-factor 0.00 %
surface roughness 0.00 nm
Remarks Cleaning result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state
hybernate
Question: controlling of Bot?

SCHEMATIC

Cleaning - Inspection Bot

SW Intro1 Intro2 Quote Logs Values

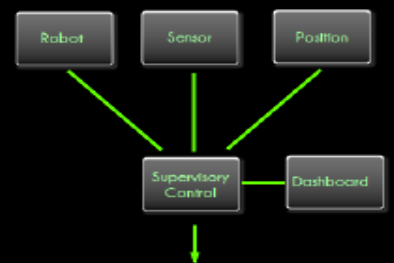
DEMO

The Smart Tooling project:

Challenge:

21st century Cleaning
21st century Inspection

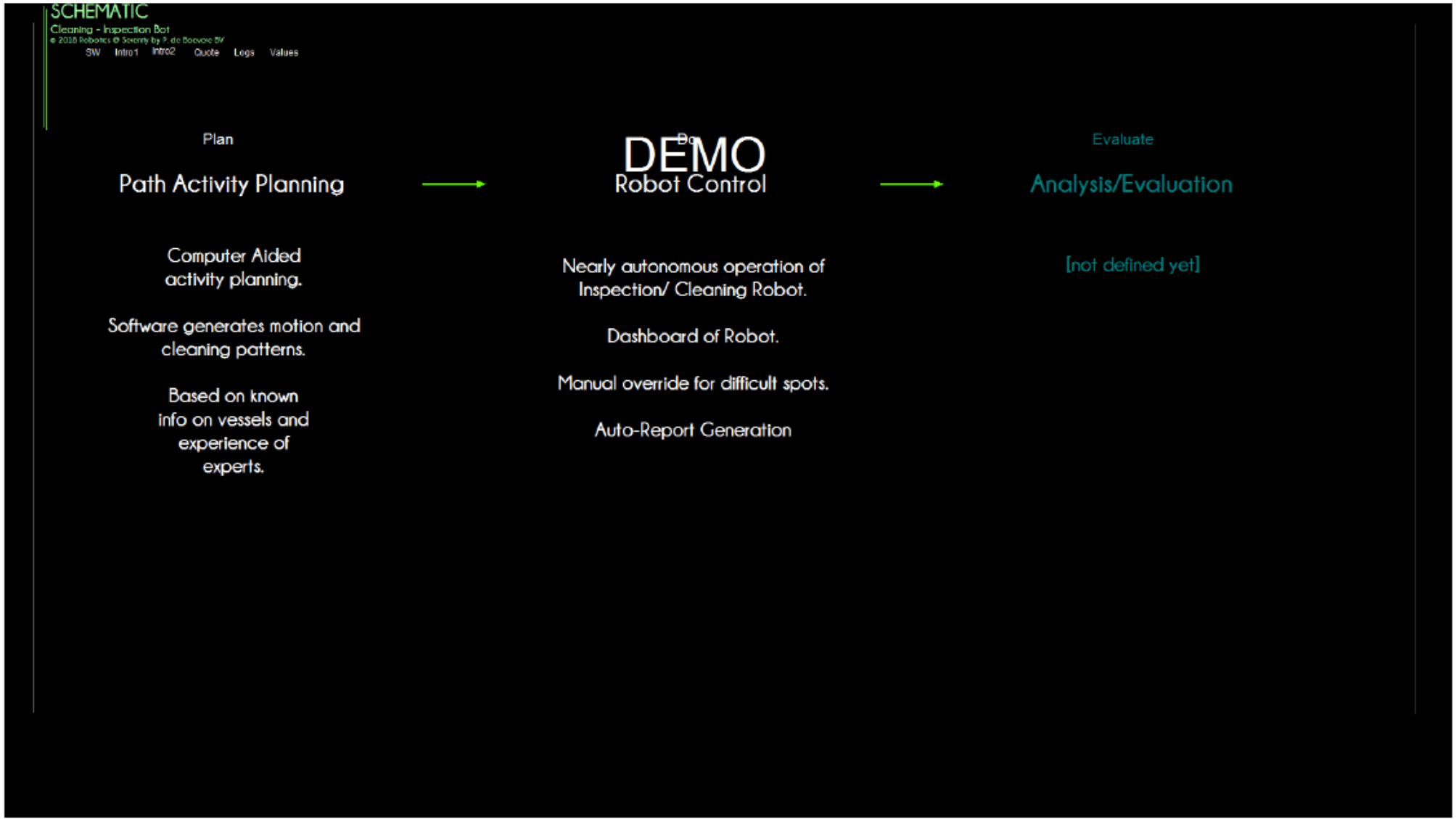
For process-industry
develop vertical tank-internal
Inspection / Cleaning Robot system



Next generation
Industrial Robotic
systems

Company role:

System integration of robotic/sensory parts
Supervisory Control
Planned Autonomous Operation
Dashboard for Robot


SCHEMATIC
Cleaning - Inspection Bot
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SW Intro1 Intro2 Quote Logs Values
Plan
Path Activity Planning
Computer Aided activity planning.
Software generates motion and cleaning patterns.
Based on known info on vessels and experience of experts.
Do
DEMO
Robot Control
Nearly autonomous operation of Inspection/ Cleaning Robot.
Dashboard of Robot.
Manual override for difficult spots.
Auto-Report Generation
Evaluate
Analysis/Evaluation
[not defined yet]

SCHEMATIC

Cleaning - Inspection Bot

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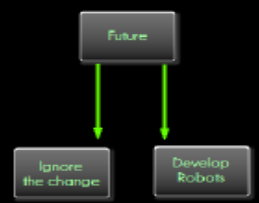
SW Intro1 Intro2 Quote Logs Values

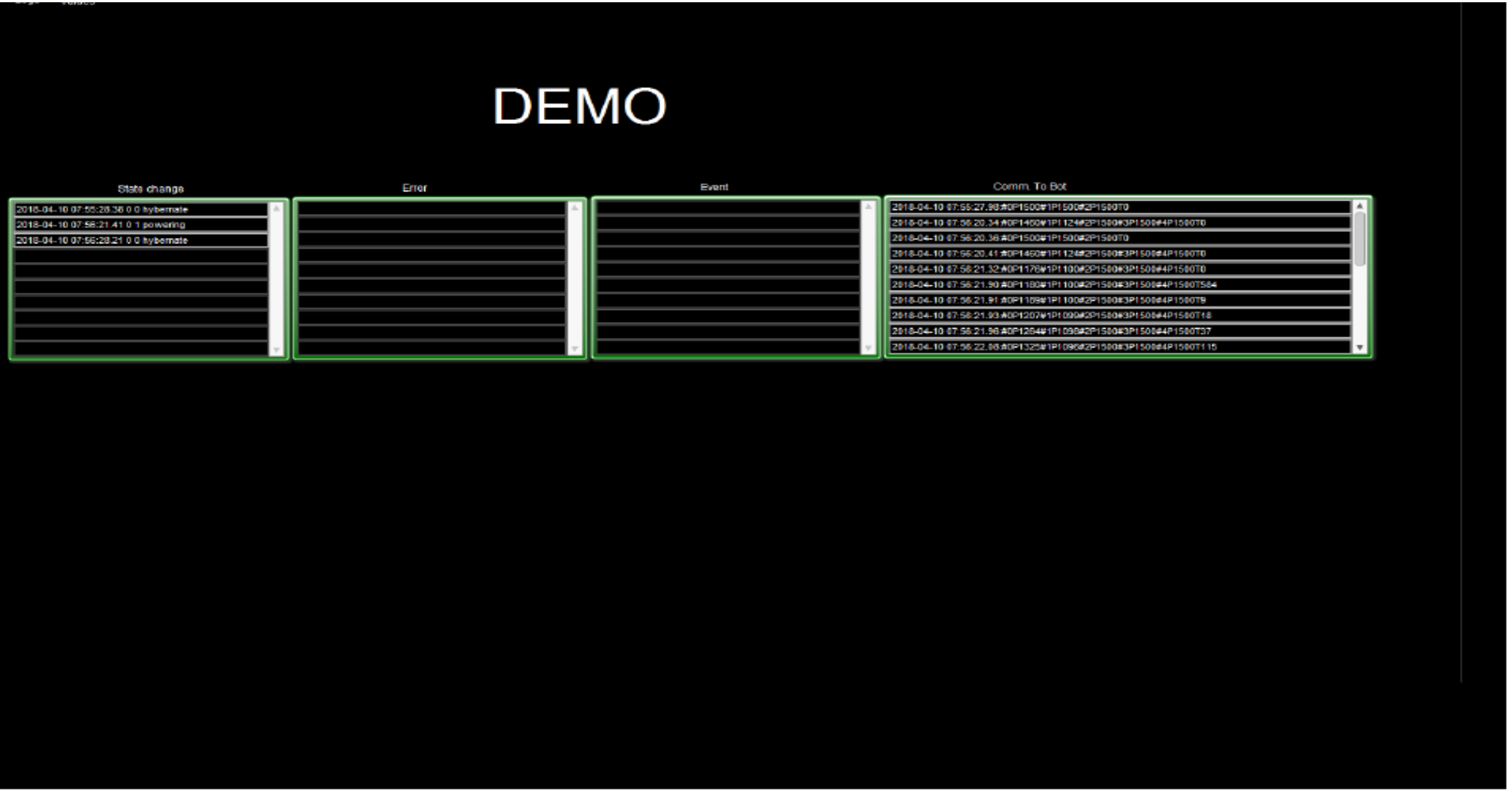
DEMO

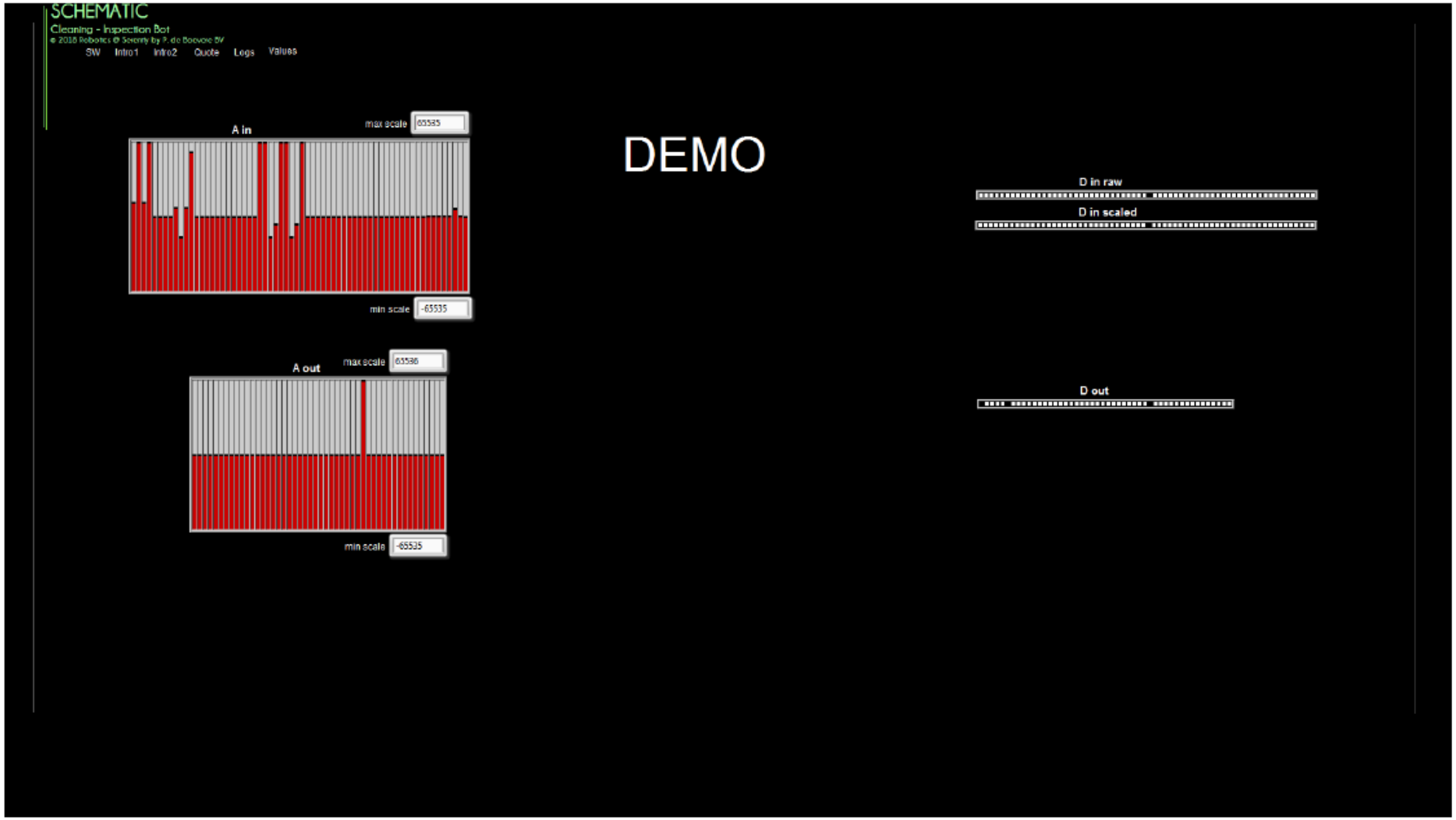
The future is autonomous Robotics.

Fight against the changes or...
help to shape a future.



DEMO


State change
2018-04-10 07:55:28.36 0 0 hybernate
2018-04-10 07:56:21.41 0 1 powering
2018-04-10 07:56:28.21 0 0 hybernate
Error
Event
Comm. To Bot
2018-04-10 07:55:27.98:#0P1500#1P1500#2P1500T0
2018-04-10 07:56:20.34:#0P1460#1P1124#2P1500#3P1500#4P1500T0
2018-04-10 07:56:20.36:#0P1500#1P1500#2P1500T0
2018-04-10 07:56:20.41:#0P1460#1P1124#2P1500#3P1500#4P1500T0
2018-04-10 07:56:21.32:#0P1176#1P1100#2P1500#3P1500#4P1500T0
2018-04-10 07:56:21.90:#0P1180#1P1100#2P1500#3P1500#4P1500T584
2018-04-10 07:56:21.91:#0P1189#1P1100#2P1500#3P1500#4P1500T9
2018-04-10 07:56:21.93:#0P1207#1P1099#2P1500#3P1500#4P1500T18
2018-04-10 07:56:21.96:#0P1264#1P1099#2P1500#3P1500#4P1500T37
2018-04-10 07:56:22.06:#0P1325#1P1099#2P1500#3P1500#4P1500T115


SCHEMATIC
Cleaning - Inspection Bot
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SW
Intro1
Intro2
Quote
Logs
Values
A in
max scale
65535
min scale
-65535
A out
max scale
65535
min scale
-65535
DEMO
D in raw
D in scaled
D out

VTEC
LASERS & SENSORS

Inspection

VTEC
LASERS & SENSORS

10 Mbit/s Optical Ethernet Transceiver

Status: Working

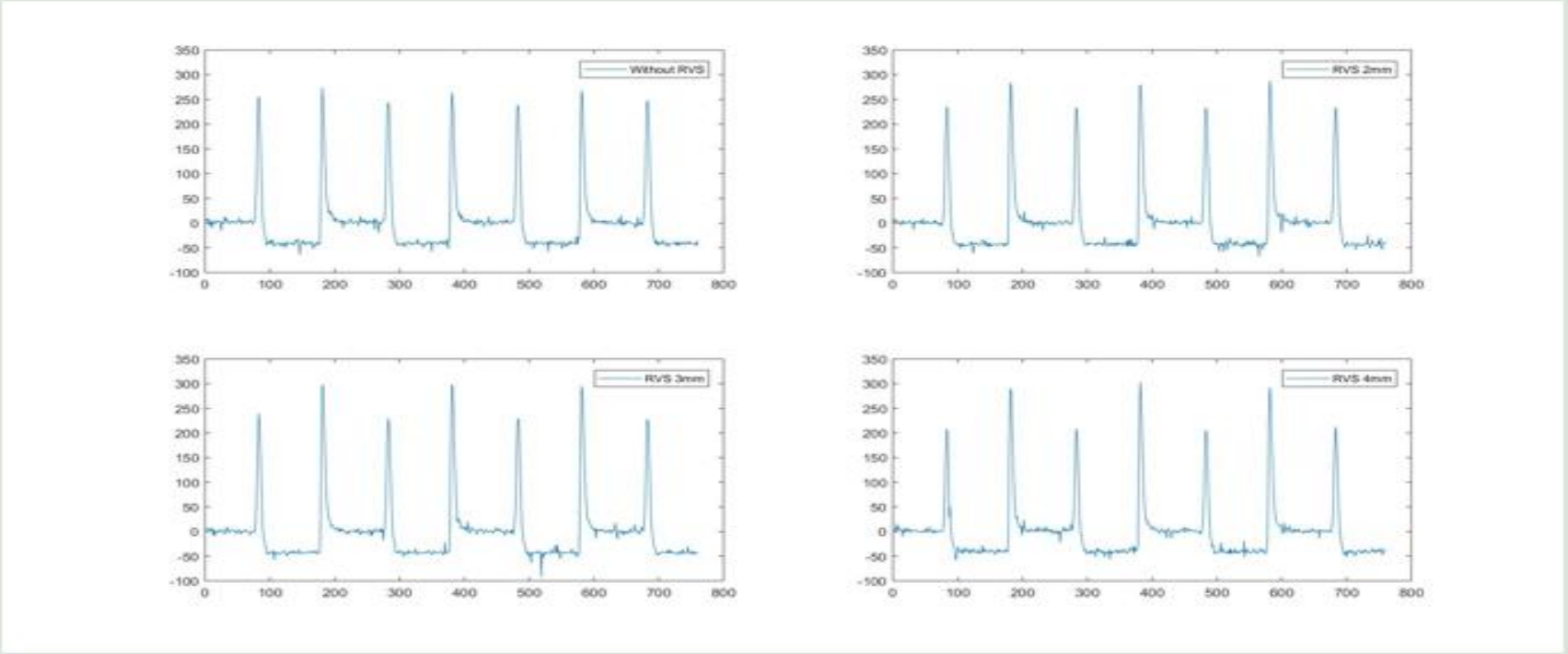
Next Step: Conducting experiments with water (different composition)

ID-tec will deliver high pressure water tube

VTEC
LASERS & SENSORS

Eddy current sensor

- Different thickness measurement
- The difference between two peaks is a linear relation with the thickness.



VTEC
LASERS & SENSORS

Eddy current sensor

- Problems with sensitivity of the sensor when going to 34 mm version
- Extensive research to find a suitable sensor but no EC sensor probe available on the market
- Problem with VTEC sensor has been solved and proto is build, still compensation needed for the robot magnet