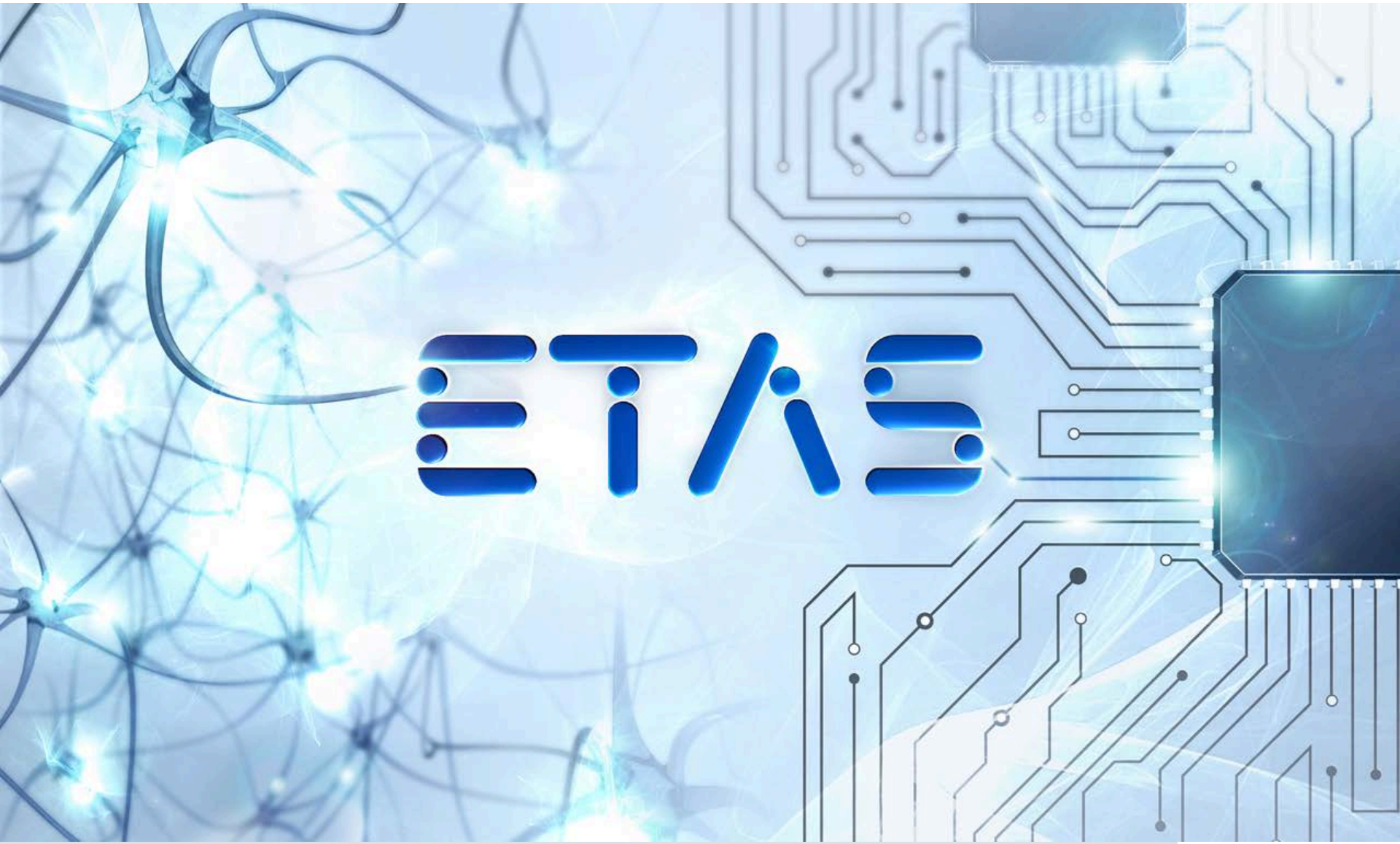
31.07.2013



# INCA Matlab Integration Package

## INCA - Matlab Integration Package

„...application programming interface that controls INCA's functionality from within MATLAB”

widely used in calibration for:

-INCA remote control and automation
-online data processing and evaluation
-algorithmic calibration

## Adressed use cases

- DoE test plan automation:
  - collecting data for data driven ASCMO models
  - generating repeating step excitation signals for system identification ASCMO-DYNAMIC

- Automation of predefined calibration processes:
  - closed-loop problems mainly, e.g. diesel soot peak emission optimization

- Online processing of measurement data:
  - complex calculations, e.g. fourier transformation
  - detector of undesired behaviour, e.g. combustion instability

- Simple bypass-like functionality (non time synchronous):
  - function bypass, e.g. using offline model via continous function output recalibration
  - closed loop controller, e.g. engine speed via accelerator pedal look-up-table

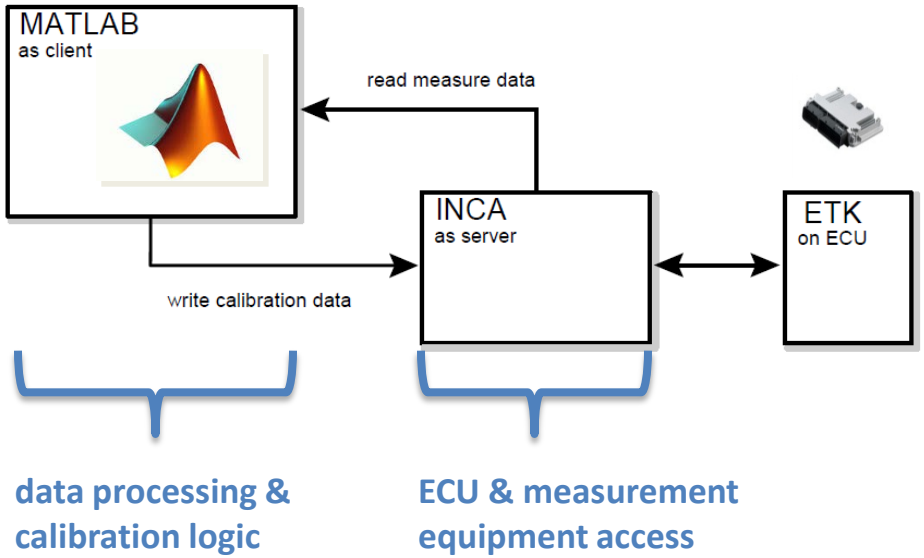
- ...

## Features

- control of GUI INCA functions by simple Matlab commands
- remote experiment setup
- data acquisition using ring buffer
- calibration access

→basis for powerful solutions in automated calibration tasks!

→basic principle: “worksplit“ between data acquisition (INCA) and data processing (MATLAB)



## Features

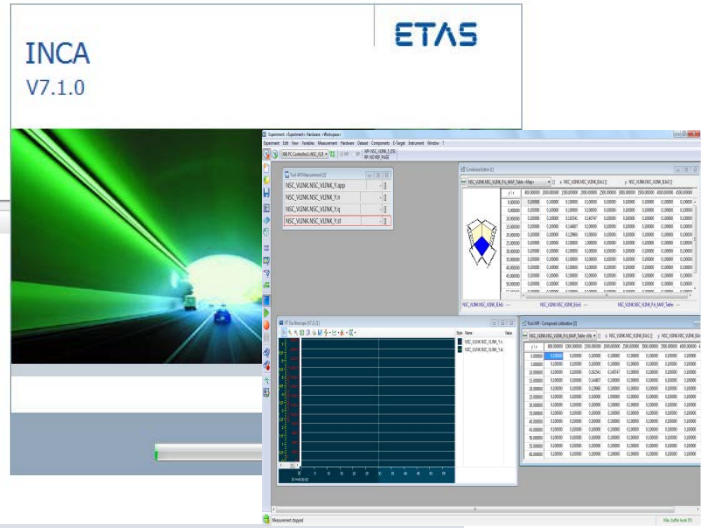
- **control of GUI INCA functions by simple Matlab commands**
- remote experiment setup
- data acquisition using ring buffer
- calibration access at breakpoint level

Example of INCA-MIP Matlab code:

```
IncaOpen('7.1')
IncaOpenDatabase;
IncaOpenExperiment('My_Project', 'My_Experiment', 'My_Project', 'My_Workspace');
```

Explanation:

starting INCA 7.1 …
open the current database
open the experiment ‘My_Experiment’ in the ‘My_Workspace ’




## Benefit

good integration of INCA into an automation toolchain

## Features

- control of GUI INCA functions by simple Matlab commands
- **remote experiment setup**
- data acquisition using ring buffer
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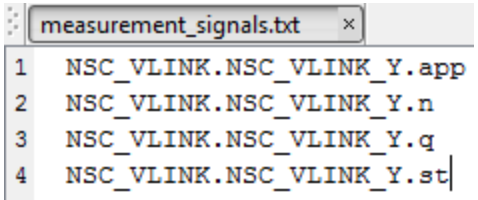


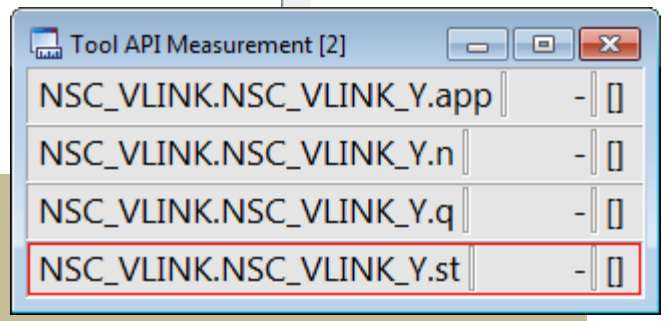


Example of INCA-MIP Matlab code:

```
signals = textread('Config\measurement_signals.txt',  '%s');

for m = 1:length(signals)
   IncaAddMeasureElement('ETKC:1' , '100 ms',  signals{m});
end
```

Explanation:

read the text file ‘measurement_signals.txt’, containing a list all the signals you want to measure

run a loop over the length of this list
   add each signal from the list to the , ‘ETKC:1’ in the ‘100 ms ‘ time raster
end

## Benefit

quick experiment setup for automation, based on exchangeable label lists

## Features

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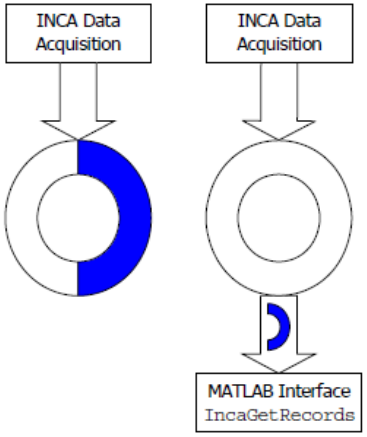



Example of INCA-MIP Matlab code:

```
IncaStartMeasurement;

[time, data] = IncaGetRecords('ETKC:1', '100 ms', 10);
```

Explanation:

start the INCA measurement first to stream data to the ring buffer

now, read the last 10 data points from the ring buffer
of the device ‘ETKC:1‘ in the ’100 ms‘ time raster
of the previously added 4 measurement signals

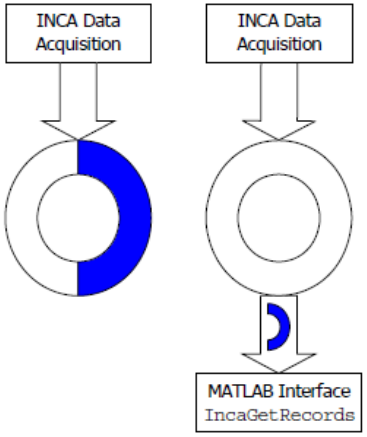
| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1 | 19.7754 | 1779 | 7.7300 | 0 |
| 2 | 19.7754 | 1.7825e+03 | 7.6000 | 0 |
| 3 | 19.7754 | 1.7825e+03 | 7.6000 | 0 |
| 4 | 19.7754 | 1785 | 7.5300 | 0 |
| 5 | 19.7754 | 1785 | 7.5300 | 0 |
| 6 | 19.7754 | 1782 | 7.6900 | 0 |
| 7 | 19.7754 | 1780 | 7.8000 | 0 |
| 8 | 19.7754 | 1780 | 7.8000 | 0 |
| 9 | 19.7754 | 1.7855e+03 | 7.6000 | 0 |
| 10 | 19.7754 | 1.7855e+03 | 7.6000 | 0 |

## Benefit

application of digital filters to process data online, like
steady state detection and low pass or moving average filtering of noisy data

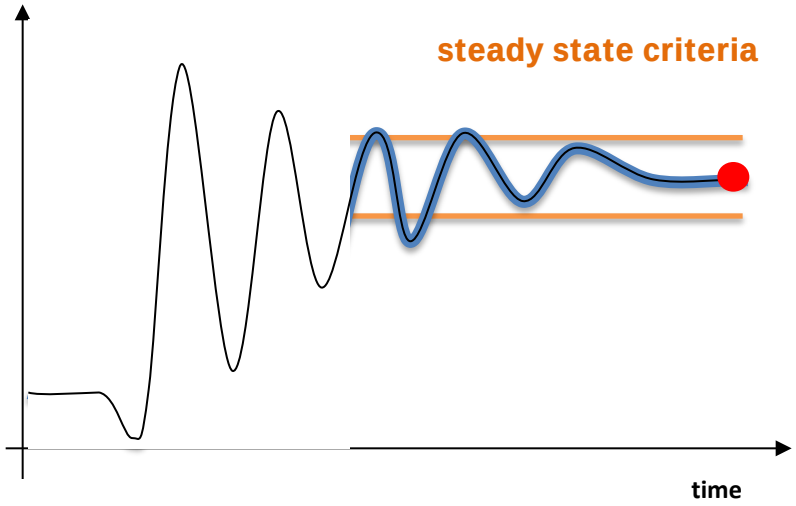
## Features

- control of GUI INCA functions by simple Matlab commands
- remote experiment setup
- **data acquisition using ring buffer**
- calibration access at breakpoint level




Steady-state detection:

means, looking at some past values at each time step and check if they meet certain the criteria...




history

current value

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1 | 19.7754 | 1779 | 7.7300 | 0 |
| 2 | 19.7754 | 1.7825e+03 | 7.6000 | 0 |
| 3 | 19.7754 | 1.7825e+03 | 7.6000 | 0 |
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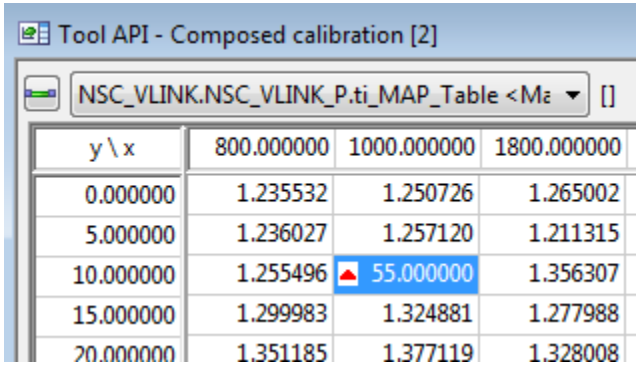
## Features

- control of GUI INCA functions by simple Matlab commands
- remote experiment setup
- data acquisition using ring buffer
- **calibration access at breakpoint level**




Example of INCA-MIP Matlab code:

```
IncaAddCalibrationElement('ETKC:1', 'EGR_rBase_MAP');

IncaSetCalibrationValue('ETKC:1', 'EGR_rBase_MAP', 55, [2, 3]);
```

Explanation:

add tha calibration map ‘EGR_rBase_MAP‘ of the device ‘ETKC:1’ to the current experiment

Change the maps 2-nd column (x break point axis) and 3-rd row (y break point axis) to the value 55