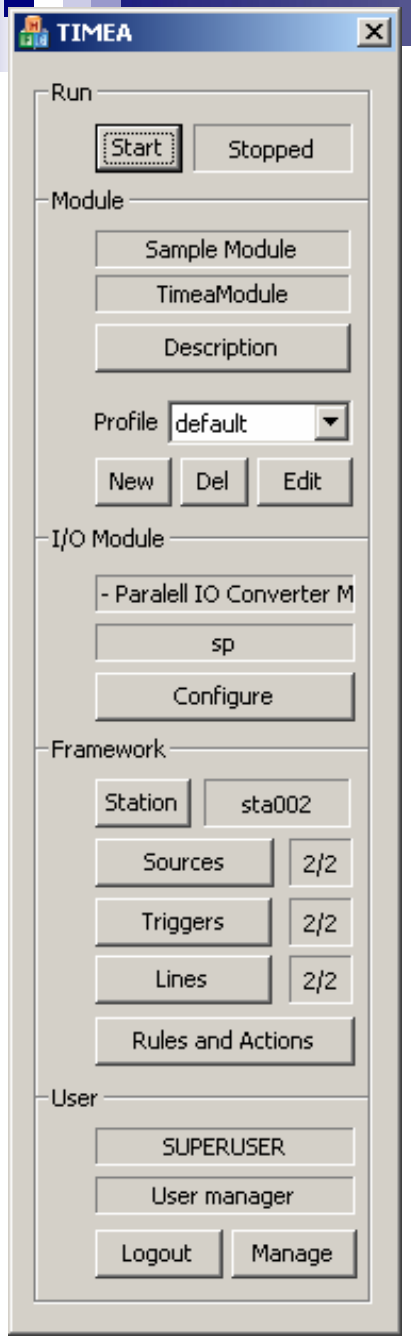
TIMEA framework

for optical monitoring of manufacturing processes

BAROSS_KD07-KD_INTEG_07-2008-0061

Requirements for TIMEA

- Capable of visual measurements, control and data acquisition
- It has modular structure, can be extended by plug-ins easily
- Applies state-of-art image processing technologies
- Can control other devices in industrial production
- Can communicate with databases



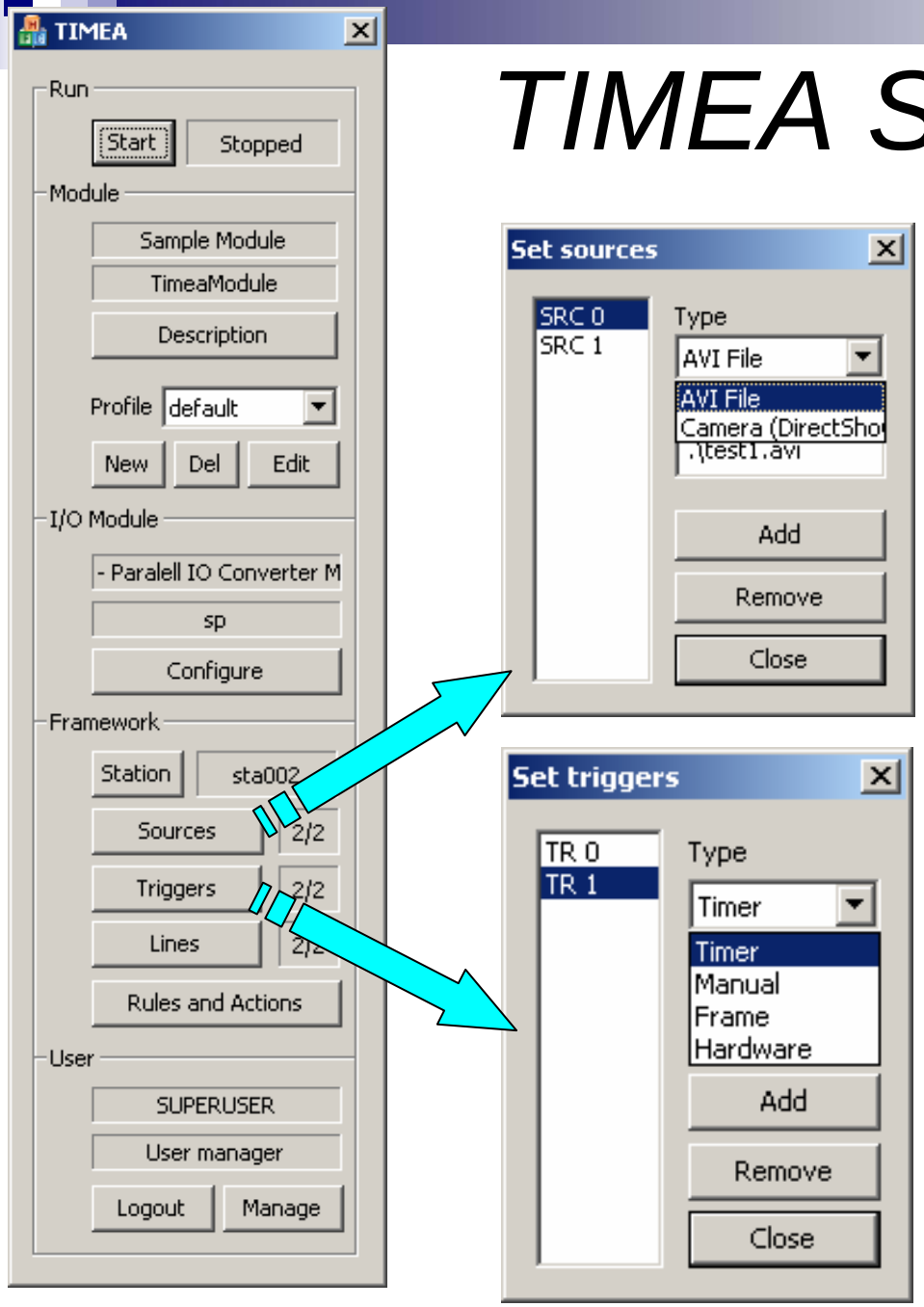
TIMEA Software

General purpose software to handle common tasks in video inspection scenarios.

Main features

- ✓ **Measuring module as a plug-in library (dll)**
- ✓ **I/O control module as a plug-in library (dll)**
- ✓ **Multiple processing lines**
- ✓ **Multiple video sources**
- ✓ **Configuration profiles for the measuring module**
- ✓ **User management**
- ✓ **Configurable hardware/software triggers**
- ✓ **Configurable output actions**
- ✓ **Detailed data logging**

TIMEA Software



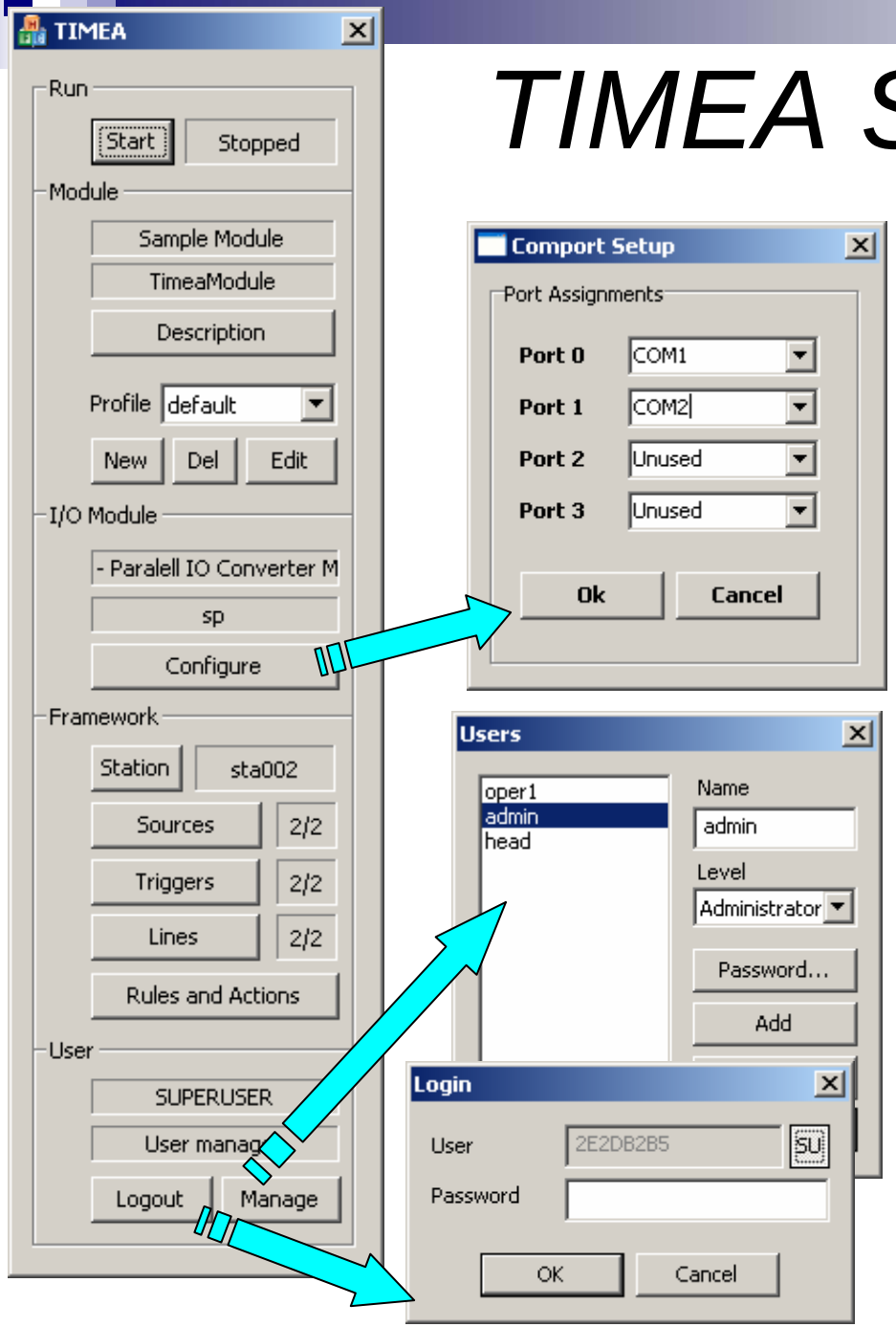
Video sources

- ✓ **Camera / Framegrabber with DirectShow interface**
- ✓ **AVI files (offline testing, pre-configuration)**

Triggers

- ✓ **Used to initiate measurement**
- ✓ **Types: Timed, Manually activated, Frame-by-frame (associated with a video source), Hardware signal**

TIMEA Software



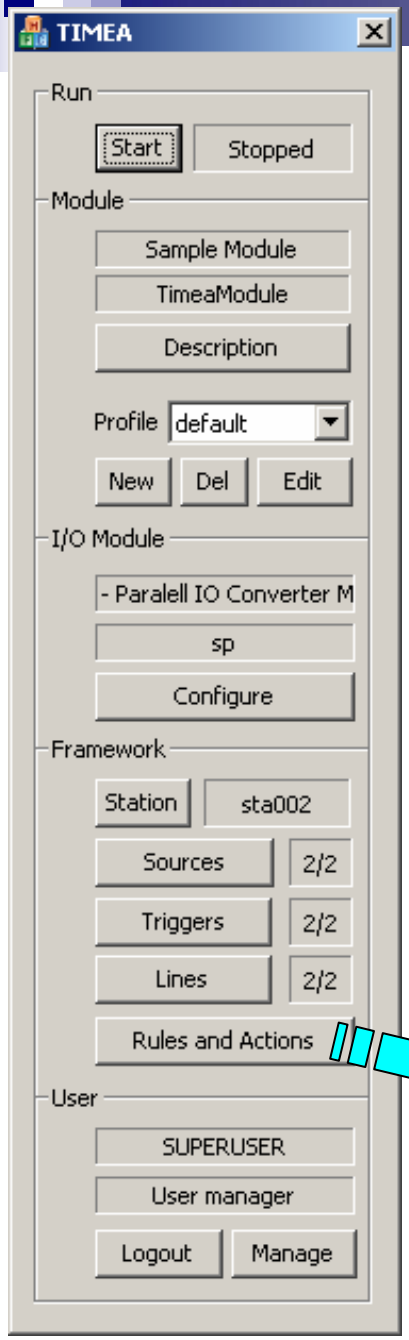
COM I/O control module

- ✓ **Sends/Receives hardware signals on serial ports (e.g. receives: „package in position” event, sends: „start/stop conveyor”)**

User management

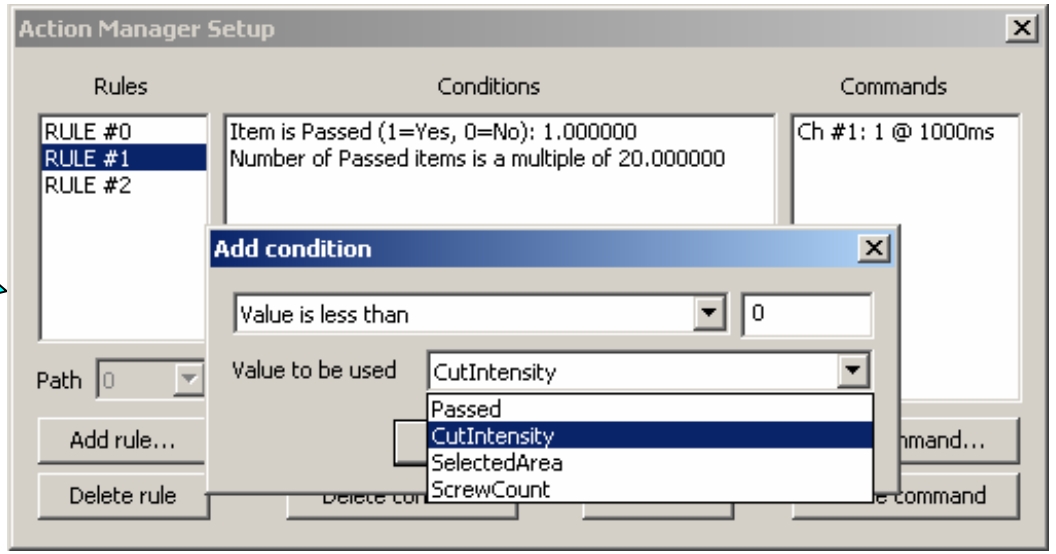
- ✓ **Operators: start/stop batch**
- ✓ **Administrators: configure the framework and the module**
- ✓ **User Managers: configure users**
- ✓ **Super-user: has all access**

TIMEA Software



Configurable actions

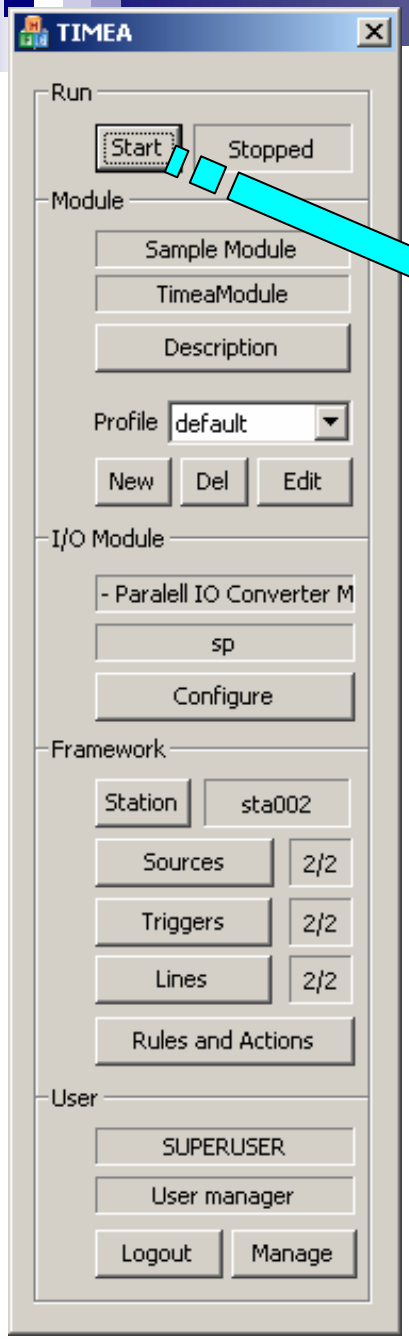
- ✓ **Rules consist of condition sets and commands**
- ✓ **Most common condition types**
- ✓ **Delayed commands (0/1 signals) for I/O module (e.g. „set channel 0 and 2 to 1 to stop conveyor and put on the check-light after each 200 good packages")**

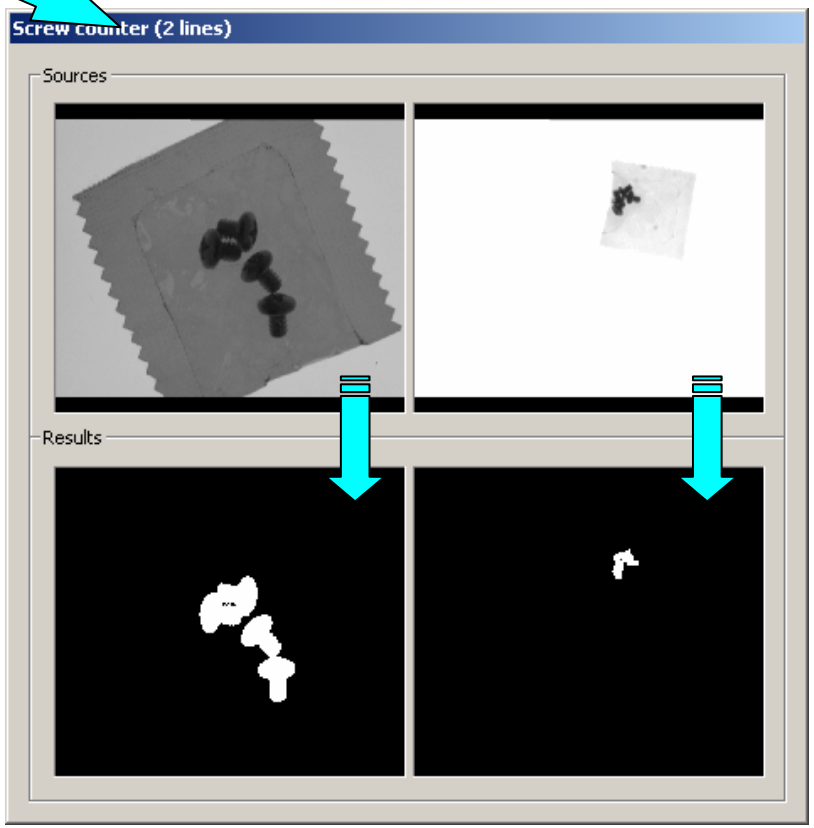


Example application: Screw Counter Module in TIMEA

- Task:
  - Counting the number of screws placed in transparent bags
  - The transparency of bags is not constant
  - The illumination from the environment is not constant

Screw Counter Module





Operator GUI

- ✓ **Visible to all users in batch mode.**
- ✓ **Input images.**
- ✓ **Segmented images (detected screws with white).**

Note the different lighting conditions – the segmentation algorithm can handle the variation as long as some basic criteria are satisfied.

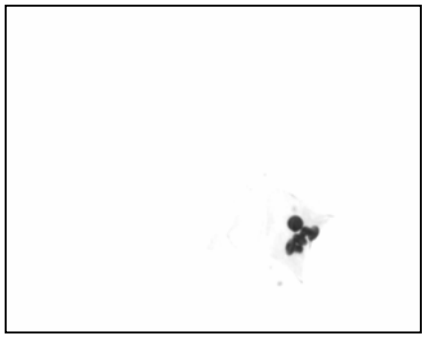
Screw Counter Module

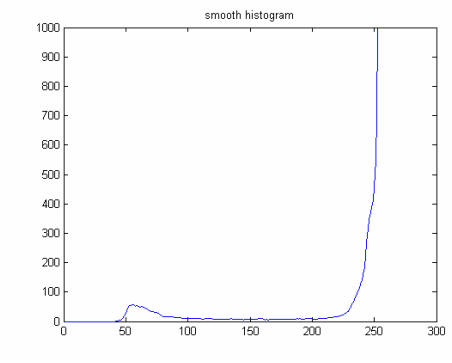
Simple gray-level histogram

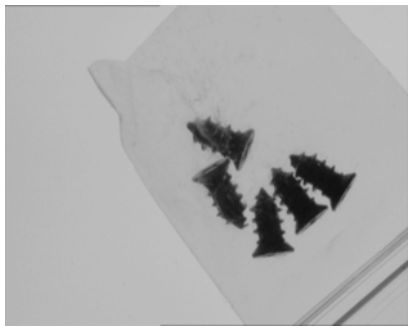
y = Probability(gray-level = x)

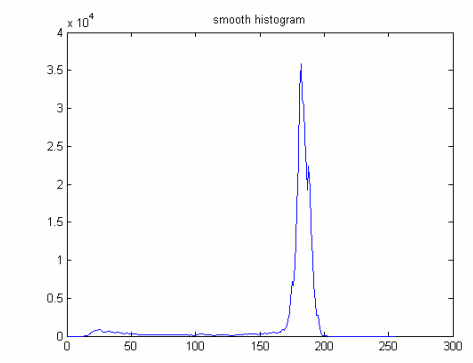
Histogram shape and modality strongly depend on

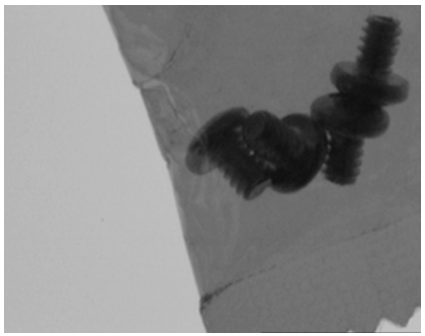
- ✓ *the size of the objects (screw, package)*
- ✓ *contrast between background, screw and package*

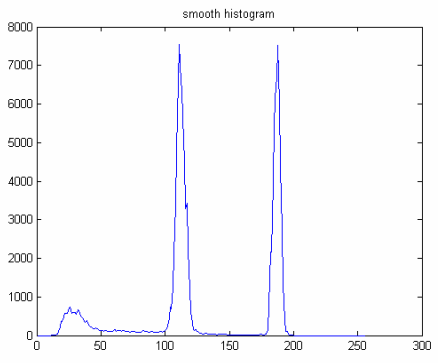












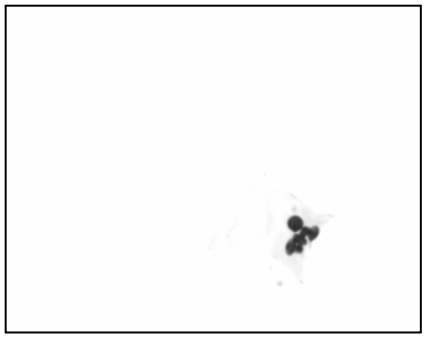
Screw Counter Module

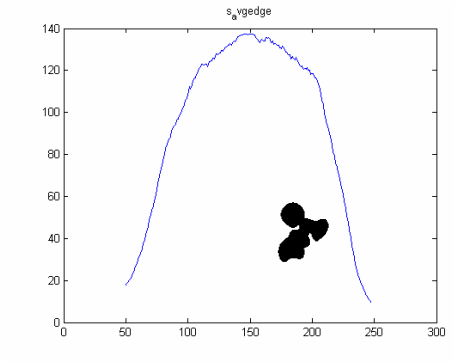
Joint gray-level – edge-level distribution

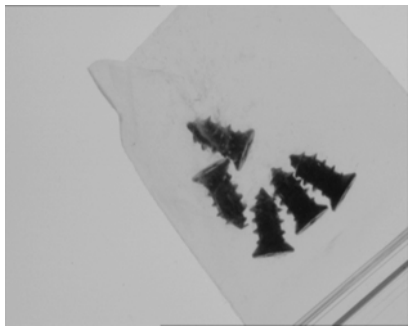
y = Estimated-value (edge-level | gray = x)

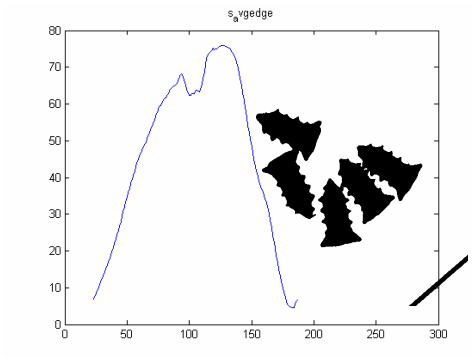
Detect screw boundary as first strong local maxima of the function.

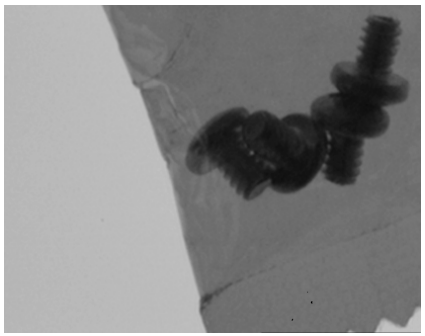
Use binary morphology and shape analysis to remove fragments.

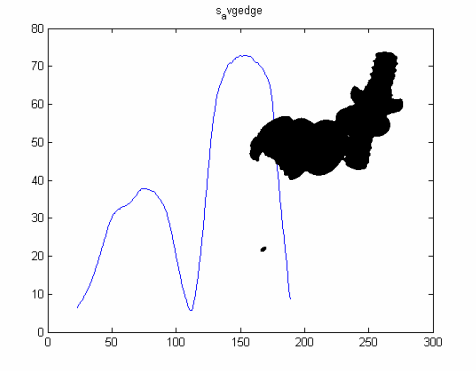




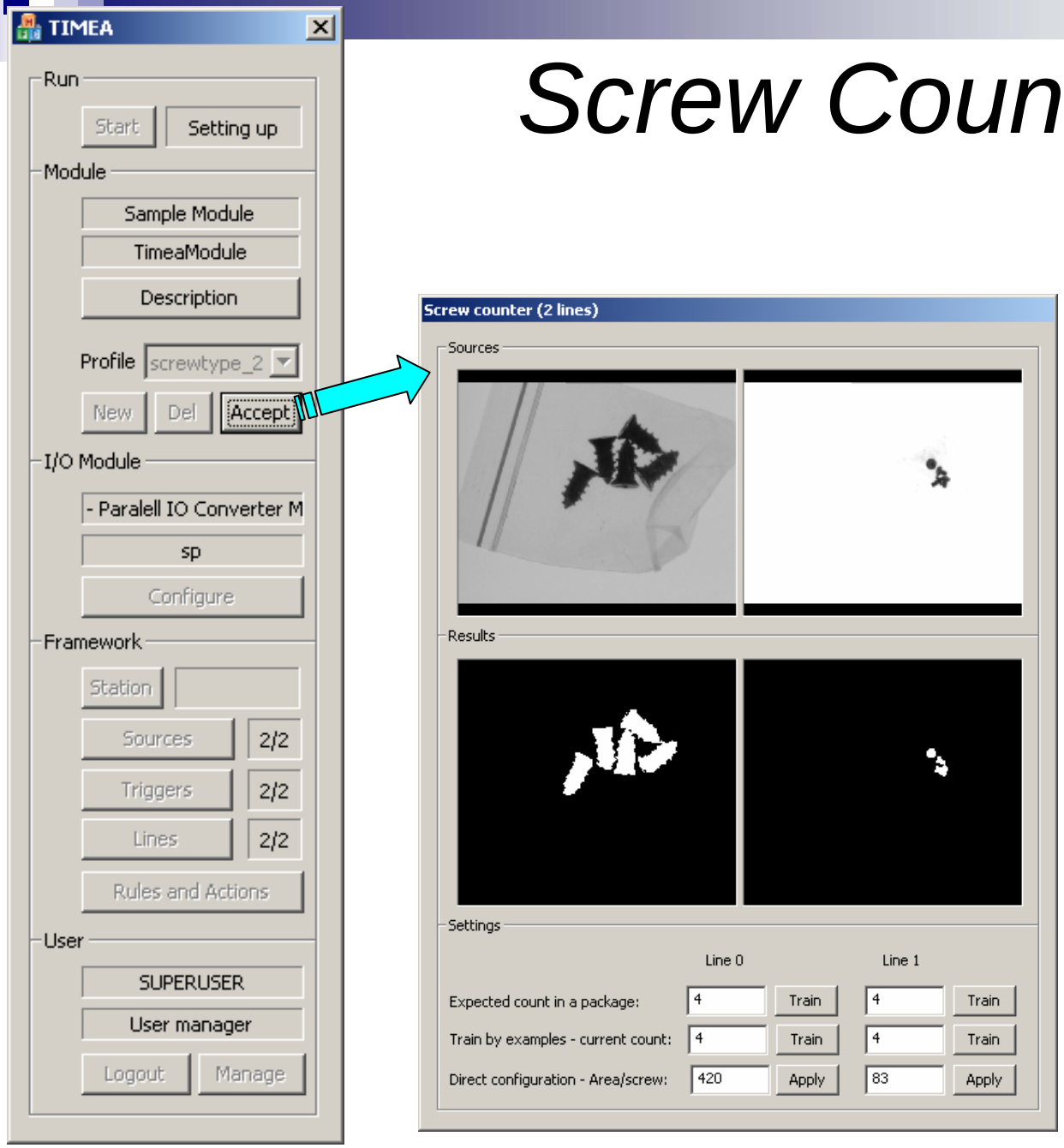








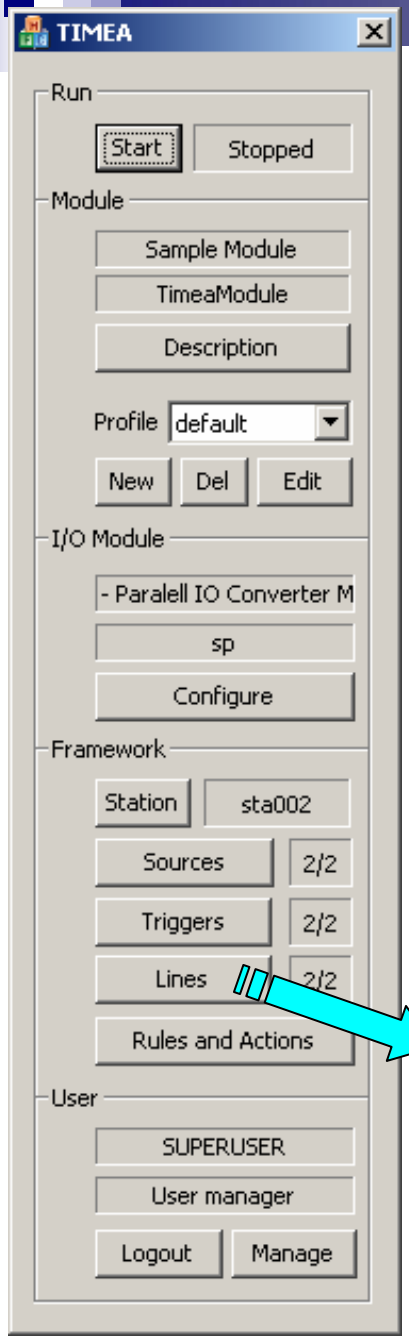
Screw Counter Module



Settings

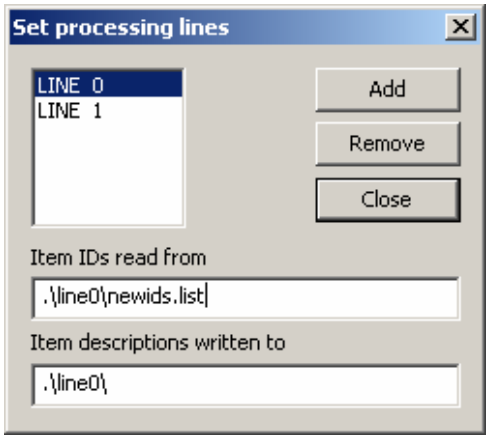
- ✓ Average area of one screw, Expected number of screws / package
- ✓ Can be trained on examples with live camera images
- ✓ Settings are saved into a profile
- ✓ Can be done by an administrator

Screw Counter Module



Data logging

- ✓ **XML descriptor for each measurement:**
  - o **General information: station, user, configuration profile, batch ID, timestamp**
  - o **Specific information (measured values): passed or not, detected screw count, cut intensity level, area of screws after segmentation.**
- ✓ **Separate output folder for each processing line**




```
– <descriptor>
    <station name="st01"/>
    <user name="oper1"/>
    <profile name="default"/>
    <batch name="batch01"/>
    <time base="2010.04.30.14:50:52"/>
  – <item id="0000059802">
      <data name="PASSED" value="1.000000"/>
      <data name="CutIntensity" value="70.000000"/>
      <data name="SelectedArea" value="16284.000000"/>
      <data name="ScrewCount" value="4.000000"/>
    </item>
</descriptor>
```