IT (Industrial Testing)

Modules for automated testing/quality control

Calculations are same GUI-based modules.

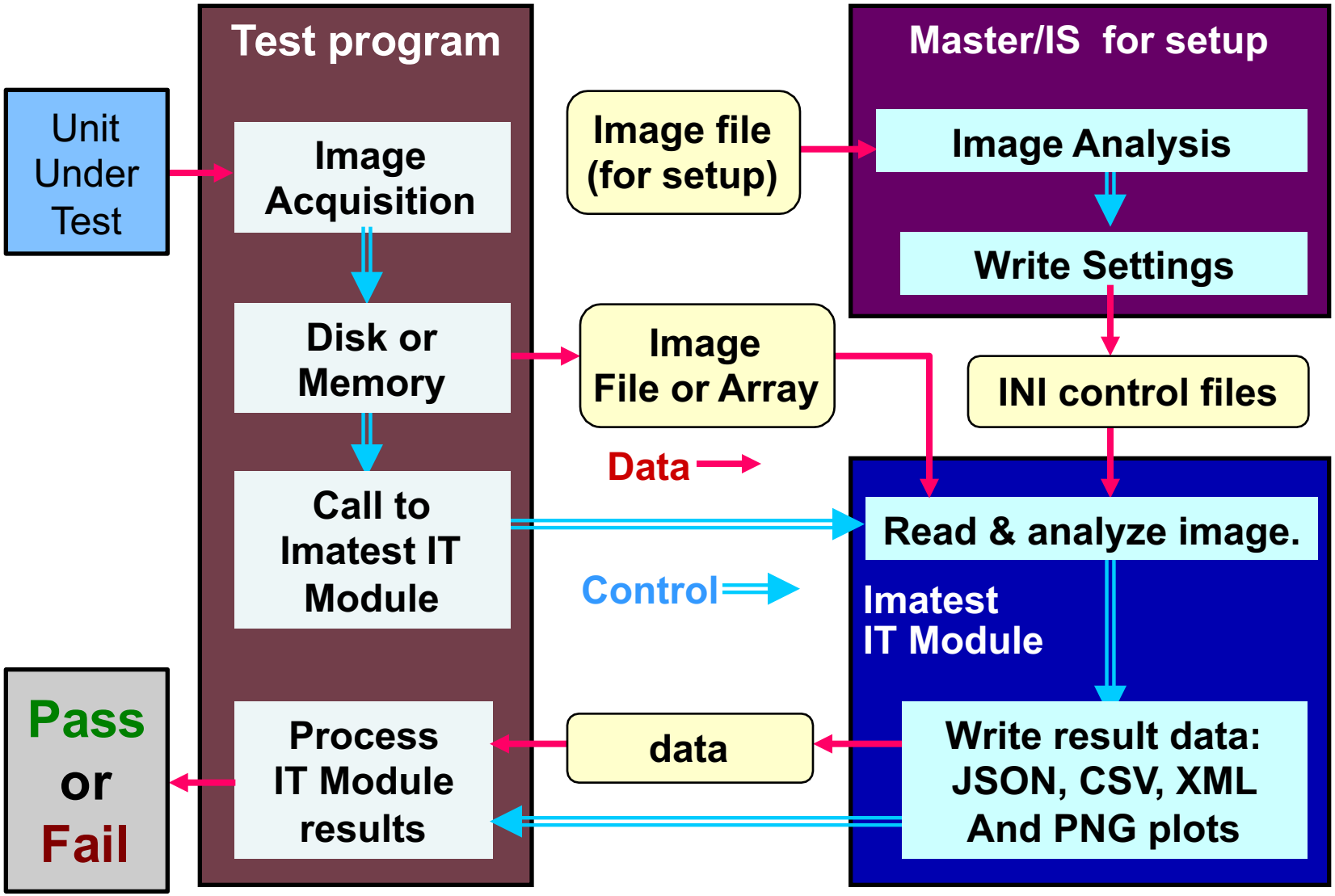
Consists of 14 modules:

SFRplus	**eSFR ISO**	**SFR**	**Wedge**
Random	**Log-f Contrast**	**Star**	**Distortion**
Blemish	**Uniformity**	**Colorcheck**	**Stepchart**
Multitest	**Dot Pattern**	**SFRreg**	**Checkerboard**

Modules can be run as:

- Executable – EXE
- Shared libraries
  - Windows:DLL, Linux:SO, Mac:Dylib
  - For use with C / C++ / Python / .NET / Labview

IT 2: Block diagram

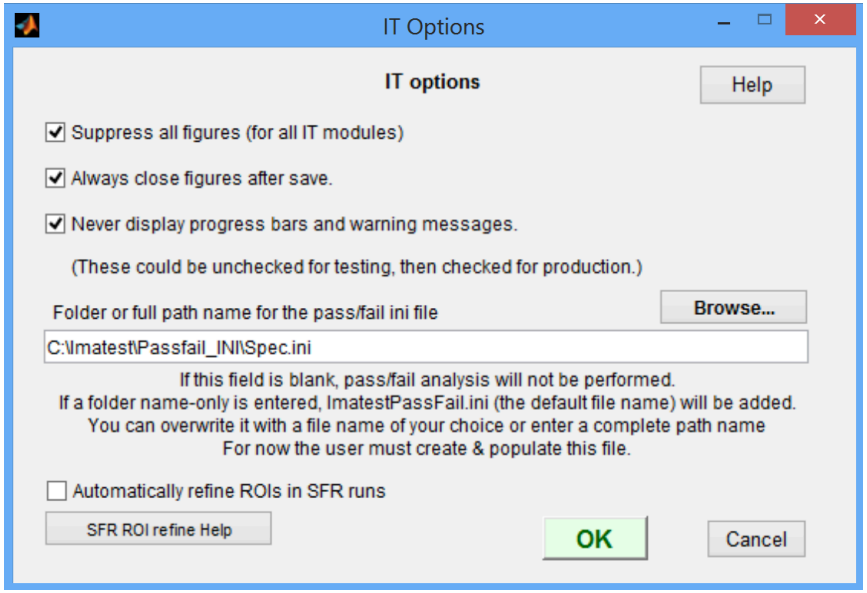


IT 3: Setup 1

In IS or Master, Click **Settings → IT Options** and make sure you have the correct options.

Checking all boxes recommended.

Interface:



Imatest.ini file:

[api]

nomsg = 1

savedel = 1

passFail = C:\camera\ModelX-Spec.ini

sfrrefine = 1

IT 4: Setup 2

3. Analyze the image file with GUI-based ***Imatest Master***.
4. Click Save settings… and save the settings in a named file. Example: api_control_xxx.ini
5. The ini file is a readable text file that can be edited– to change file names when moving between computers, change settings, or remove irrelevant entries.

IT 5: DOS call to EXE

Issue a DOS call from the calling program. Format:

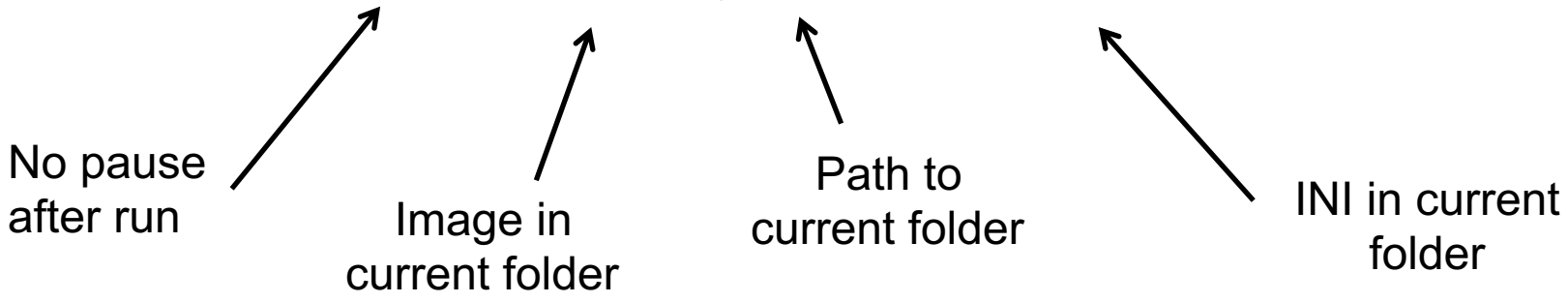
[module].exe param-1 param-2 param-3 param-4 param-5

(The parameters are listed in the next page)

Example:

"C:\Program Files\Imatest\v4.5\IT\bin\sfrplus.exe"

-1 .\sfrplus.png . .\Imatest.ini



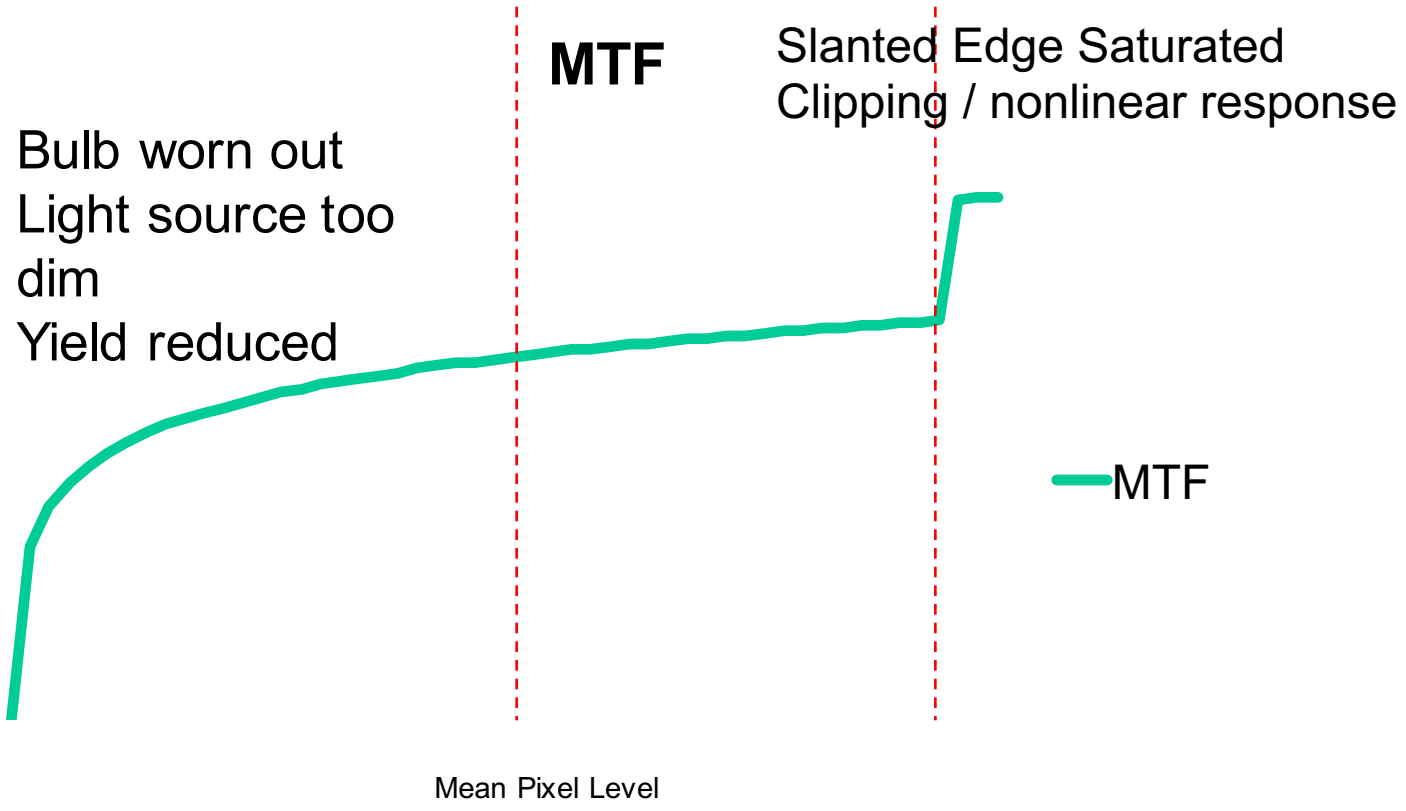
IT 6: EXE Call parameters

EXE call: [Module].exe param-1 param-2 param-3 param-4 param-5

Param	
1	-1 closes all figures after the run ends. (Normal operation) -2 keeps the DOS window open after the program terminates. -3 and -4 are similar to -1 and -2 but open the error log file
2	Image file name
3	Folder where the IT and other programs are located. e.g.: “c:\program files\imatest\IT\bin\”
4*	.ini file name. If omitted, it defaults to imatest.ini.
5*	folder where results are written. defaults to Results/ folder in the directory with image file.

Preventing Darkness & Saturation

- Bulb worn out
- Light source too dim
- Yield reduced



IT 8: Pass Fail INI File – SFRplus 1/2

Center means <0.3 Field

[sfrplus]
Secondary_readout_1_center_mean_min = .69
Secondary_readout_1_outer_mean_min = .5
Secondary_readout_2_center_mean_min = .3
Secondary_readout_2_outer_mean_min = .15
Rotation_degrees_max = 1.5
FOV_degrees_diagonal_min = 67
Convergence_angle_max = 1.6

Secondary Readouts are selected during SFRplus setup

For example:
Secondary_readout_1 means MTF@0.250*Nyquist

Secondary_readout_2 means MTF@0.5*Nyquist

Outer means >=0.3 Field

… continued …

Tilt test

IT 9: Pass Fail INI File – SFRplus 2/2

Distortion Bars In Image

Found all required ROIs

Color demosaic proper

Don't allow flipped chart

Don't allow too bright/dark

Don't allow oversaturated Image (non-linear clipping)

Offset Sqrt($X^2 + Y^2$) max

[sfrplus] … continued …

Horizontal_bars_OK_min = 1
All_Edge_IDs_detected = 1
Bayer_decode = 1
Mirrored_chart = 1

Chart_mean_pixel_level_bounds = .3 .8
Low_pixel_saturation_fraction_max = .3
High_pixel_saturation_fraction_max = .3
Chart_radial_pixel_shift_max = 18

IT 10: Pass Fail INI File – Blemish Detect

Defect Pixels →
Optical Center →
Corner Difference →
Uniformity Ratios →
Blemishes →

```
[blemish]
Dead_pixels_max = 50
Hot_pixels_max = 50
Optical_center_offset_max = 30
Relative_illumination_worst_corner_pct_min = 29
Relative_illumination_corner_diff_pct_max = 21
Uniformity_RoverG_corners_pct_max = 10.8
Uniformity_BoverG_corners_pct_max = 13.9
Blemish_size_pixels = 20 49
Blemish_maximum_count = 2 1
```

2 blemishes of 20 pixels allowed
1 blemish of 49 pixels allowed
More blemishes? FAIL!

IT 11: Pass Fail Monitor

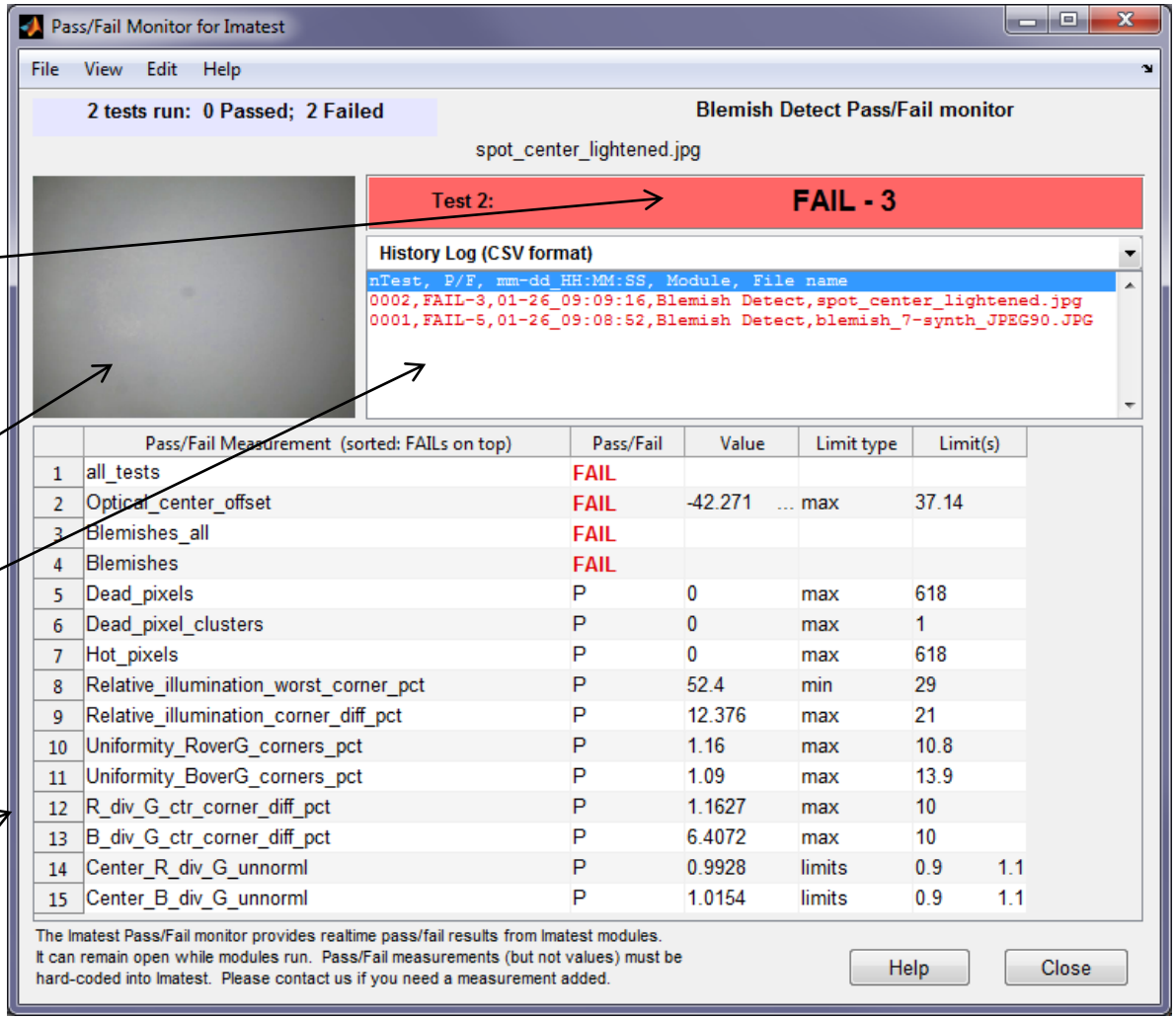
Run from main Imatest window; supported by nearly all fixed & interactive modules. Preview of Pass/Fail results.

Main P/F indicator (**green for P**; **red for F**)

Image thumbnail

History or original results data structure

Parsed results with **FAIL**s on top



IT 12: JSON Output Format

Imatest outputs files in JSON format:

```
{
      “Json Files”  :
            { “Are easy to read”  :  [“by a human”,
                                      “by a computer program”],
              “Are better than” : [“CSV”, ”XML”,
                                   ”Reading plots”]
            }
      “Strings”       :     “Asdf”,
      “Objects”       :     {  “Key”  : “Value”,      “foo” : “bar” },
      “Arrays”        :     [0, 1, 2, 3, 4, 5],
}
```

JSON files can be easily processed by most programming languages. See http://www.json.org .

IT 13: JSON Test Results

Inside SFRplus Outputs


```
"passfail": {
        "started_at": "2012-09-18 21:48:11",
        "part_number": "720Pcam",
        "serial_number": "123",
        "ended_at": "2012-09-18 21:48:13",
        "all_tests_passed": [1],
        "Rotation_degrees_max": [1],
        "Rotation_degrees": [0.1544402431],
        "Rotation_degrees_passed": [1],
        "FOV_degrees_diagonal_min": [65],
        "FOV_degrees_diagonal": [71.48887417],
        "FOV_passed": [1],
        "Convergence_angle_max": [1],
        "Horizontal_convergence_angle_degrees": [0.1962654529],
        "Horizontal_convergence_angle_passed": [1],
        "Vertical_convergence_angle_degrees": [-0.1782540181],
        "Vertical_convergence_angle_passed": [1],
        "Secondary_readout_1_center_mean_min": [0.69],
        "Secondary_readout_1_center_name": "MTF @ 0.125 C/P",
        "Secondary_readout_1_center_mean": [0.7605115781],
        "Secondary_readout_1_center_mean_passed": [1],
        "Secondary_readout_1_outer_mean_min": [0.5],
        "Secondary_readout_1_outer_name": "MTF @ 0.125 C/P",
        "Secondary_readout_1_outer_mean": [0.6414709955],
        "Secondary_readout_1_outer_mean_passed": [1],
        "Secondary_readout_2_center_mean_min": [0.3],
        "Secondary_readout_2_center_name": "MTF @ 0.250 C/P",
        "Secondary_readout_2_center_mean": [0.4810220612],
        "Secondary_readout_2_center_mean_passed": [1],
        "Secondary_readout_2_outer_mean_min": [0.15],
        "Secondary_readout_2_outer_name": "MTF @ 0.250 C/P",
        "Secondary_readout_2_outer_mean": [0.3197757488],
        "Secondary_readout_2_outer_mean_passed": [1]
}
```


Inside Blemish Outputs


```
"passfail": {
        "started_at": "2014-06-13 21:44:05",
        "part_number": "1080Pcam",
        "serial_number": "123",
        "ended_at": "2014-06-13 21:44:07",
        "all_tests_passed": [1],
        "Dead_pixels_max": [300],
        "Dead_pixels": [2],
        "Dead_pixels_passed": [1],
        "Hot_pixels_max": [300],
        "Hot_pixels": [0],
        "Hot_pixels_passed": [1],
        "Optical_center_offset_max": [90],
        "Optical_center_offset": [-20.73147695,-2.589069404],
        "Optical_center_offset_radial": [20.89252059],
        "Optical_center_offset_passed": [1],
        "Relative_illumination_worst_corner_pct_min": [27],
        "Relative_illumination_worst_corner_pct": [37.4989815],
        "Relative_illumination_worst_corner_passed": [1],
        "Relative_illumination_corner_diff_pct_max": [31],
        "Relative_illumination_corner_diff_pct": [4.813874468],
        "Relative_illumination_corner_diff_pct_passed": [1],
        "Uniformity_RoverG_corners_pct_max": [13.9],
        "Uniformity_RoverG_corners_pct": [1.87],
        "Uniformity_RoverG_corners_pct_passed": [1],
        "Uniformity_BoverG_corners_pct_max": [13.9],
        "Uniformity_BoverG_corners_pct": [1.17],
        "Uniformity_BoverG_corners_pct_passed": [1],
        "Blemishes_detected_pixel_size": null,
        "Blemishes_passed": [1,1],
        "Blemish_size_pixels": [49,49],
        "Blemish_maximum_count": [2,1],
        "Blemishes_all_passed": [1]
}
```

IT 12: Acquire Image Routine

The Imatest IT image acquisition library, called through the Imatest IT shared library, allows you to use use all Imatest IS supported acquisition interfaces

See imatest.com/acquire for all supported hadware

Show supported devices:

list_devices(int nargout, mwArray &devices);

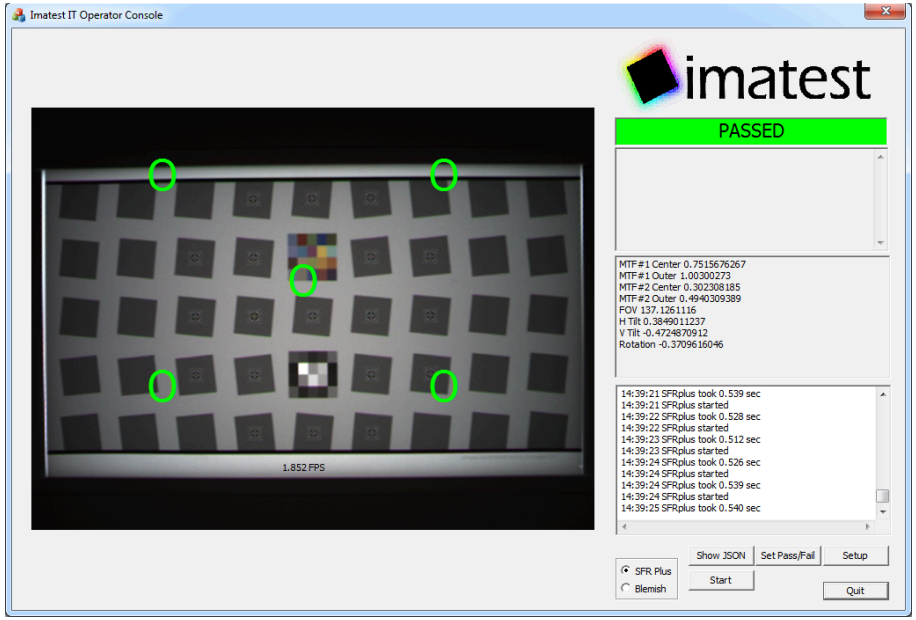
Acquire image from device:

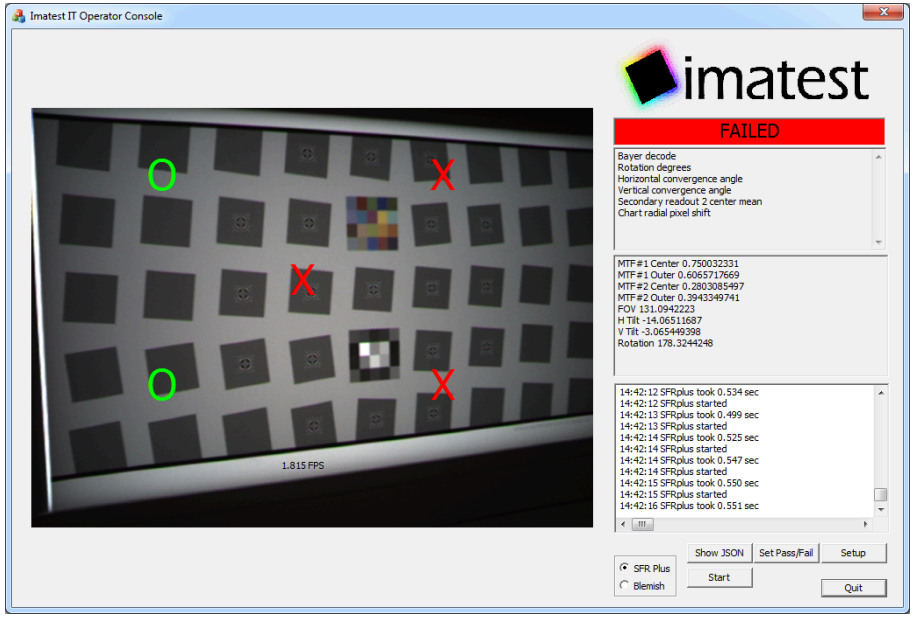
acquire_image(int nargout, mwArray &im_orig, mwArray &vstr, const mwArray &source_id, const mwArray &varargin);

IT 13: Operator Console

Manufacturing Test Interface

- Simple Pass/Fail GUI for Imatest IT
- Integrate with factory control & automated test equipment
- Open source project written in MFC C++
- To be ported to cross-platform GUI framework in future (QT, GTK or Java)





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Thank You For Attending Our Class!

We appreciate you attending our class and look forward to working with you.

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Best Regards,

-The Imatest Team

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