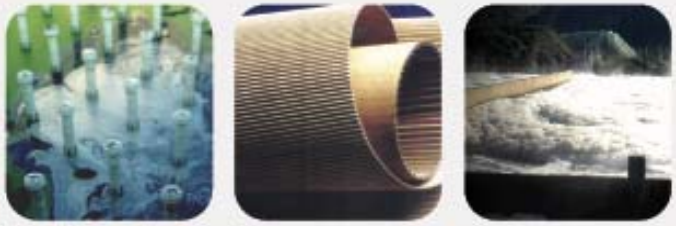
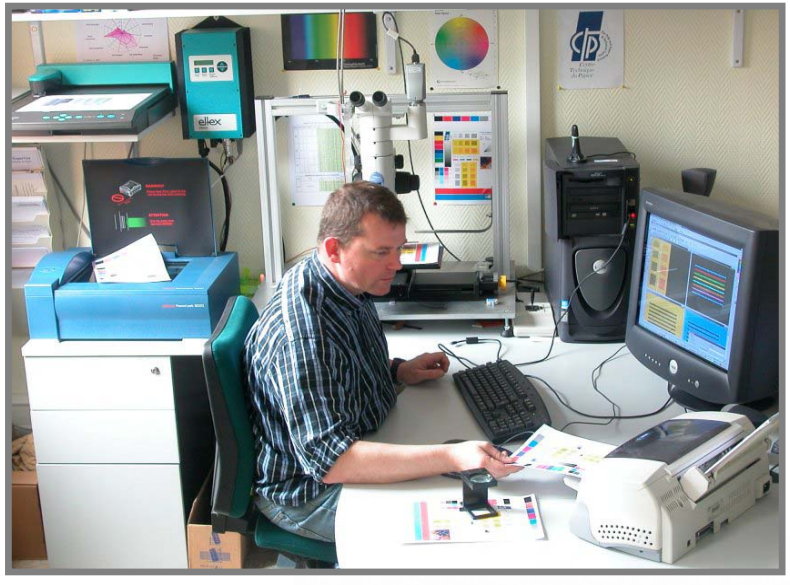
Prediction of inkjet printing quality using i.JetSET device

Christophe TREHOULT



centre technique du papier

- A part of the digital printing research program of CTP (2002-2004)
- To develop a complete system to evaluate ink jet printing quality by IA in correlation with visual ranking



Why ?

- None existing standard system to measure Ink-Jet printing quality
- Growing demand of industrial partners.
  - ✓On line measurement for process control.
  - ✓Research & development of new coating.
  - ✓BENCHMARKING

Aims

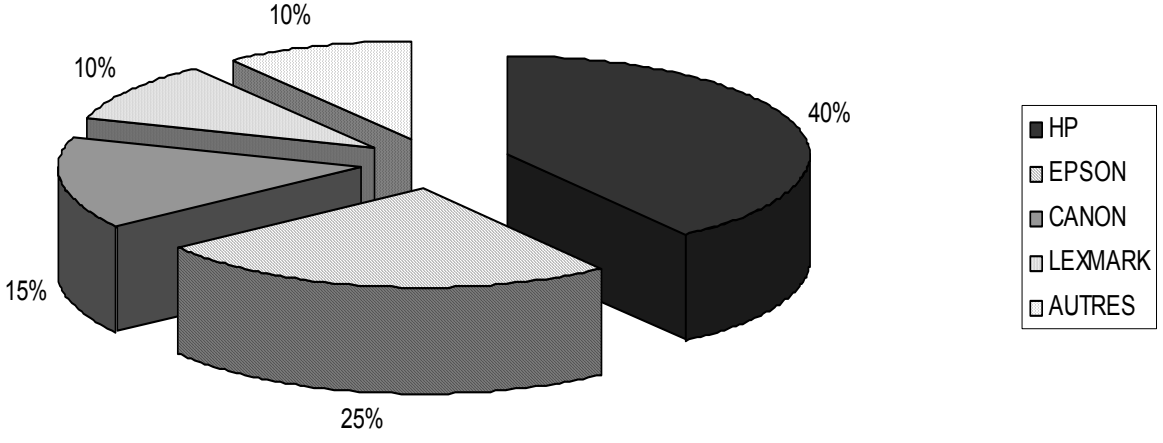
- Print quality assessment using visual scales
- Transfer the know-how of the CTP expert team into a machine
  - ✓Sensitivity
  - ✓Reproducibility
  - ✓Automatisation
- Full & efficient system
  - ✓Ink jet and other processes
- To be able to give one global measurement of printing quality for each sample.

Set of papers

- Plain papers
  - ✓Multifonctional
  - ✓Enhanced for Inkjet
- Coated
  - ✓Matt
  - ✓Glossy
- Sources
  - ✓Printer manufacturer
  - ✓Paper maker
  - ✓Available on the market
  - ✓In development

Categories of printers

- Several generations of printers from 1999 to 2006
- Several purposes
  - ✓Report editing
  - ✓Photo reproduction
  - ✓Multifonctional machines
- Different manufacturers – Main competitors in this field



Source Distributique 2005

Set of printers

- **HP**
  - Deskjet 815c, Deskjet 5850, Photosmart HP8250
- **Epson**
  - Stylus color 740, Stylus C70, Stylus Photo 890, Stylus C84, Stylus D88,
  - Stylus Pro 4000 (Wide format)
- **Canon**
  - BJC 6000, i865, Pixma iP4200
- **Lexmark**
  - (Z45)

- **Pigments/ dyes based inks**
- **Piezo and thermal technologies**

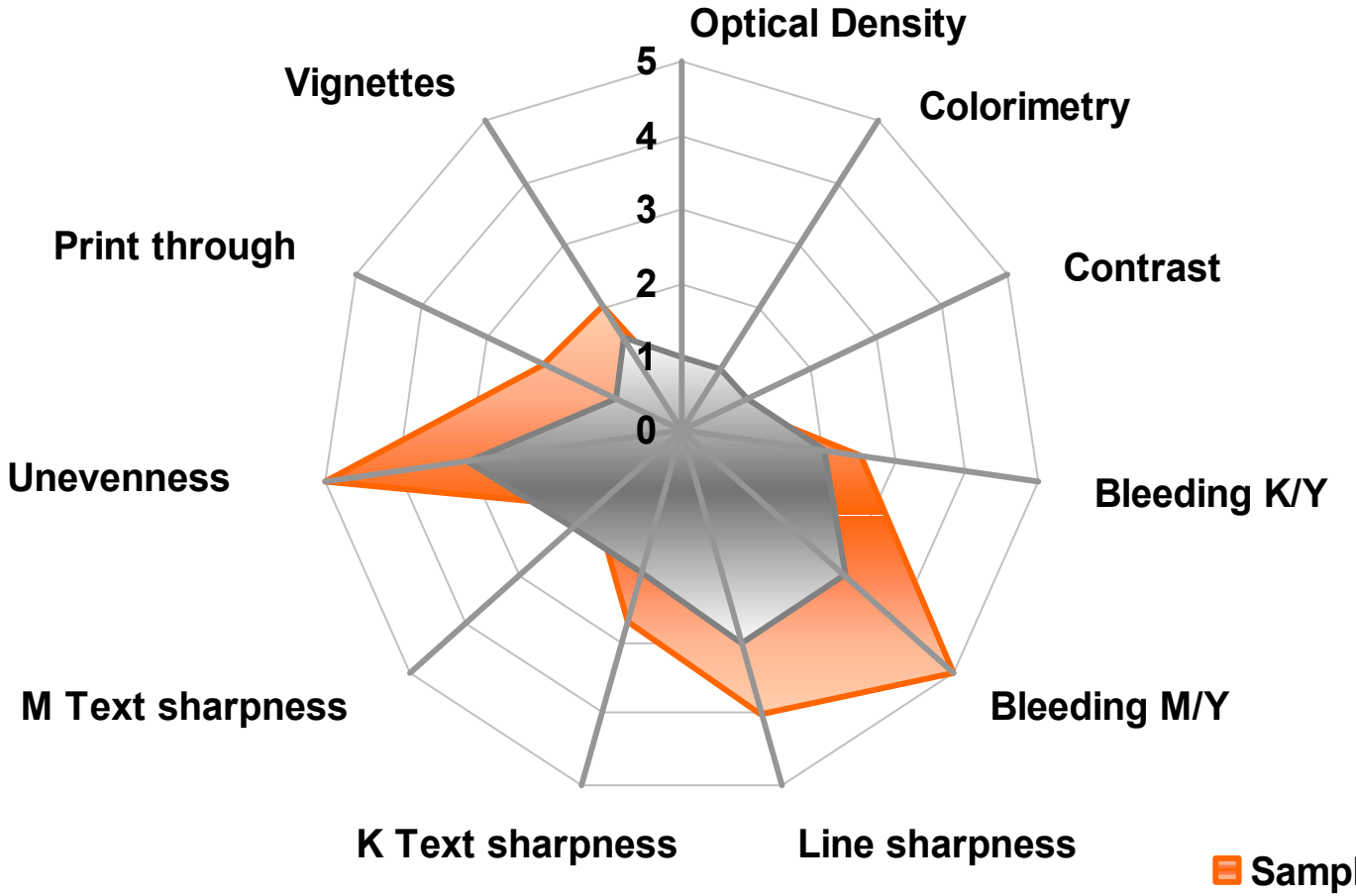
Print quality & human evaluation

- **Human scales - Print quality expert team since 1999**
  - CTP
  - Others (Paper makers, suppliers, printers..)
- **Print quality index (for each measure)**
  - Human evaluation scales
    - ✓Bleeding
    - ✓Print unevenness
    - ✓Print trough
    - ✓Ink spreading
    - ✓Text sharpness
    - ✓Vignettes
  - 0 = Very good
  - 5 = Very bad

Summary of measures

- Optical density *(Black)*
- Gamut – Colorimetry
- Contrast *(Black)*
- Bleeding
  - ✓ Black / Yellow
  - ✓ Magenta / Yellow
- Line sharpness *(Black)*
- Text sharpness
  - ✓ Black
  - ✓ Magenta / Cyan
- Unevenness *(Blue)*
- Print through
- Vignettes

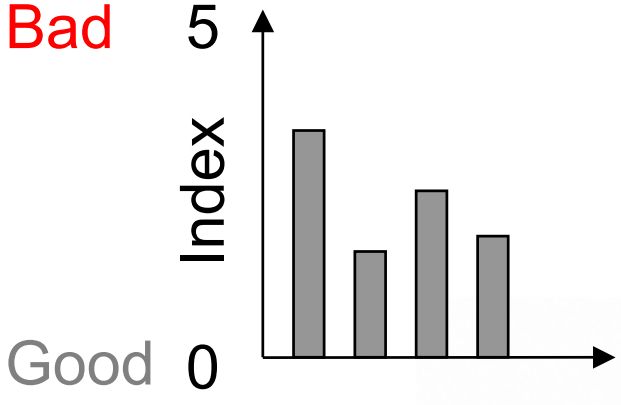
Printing quality criteria

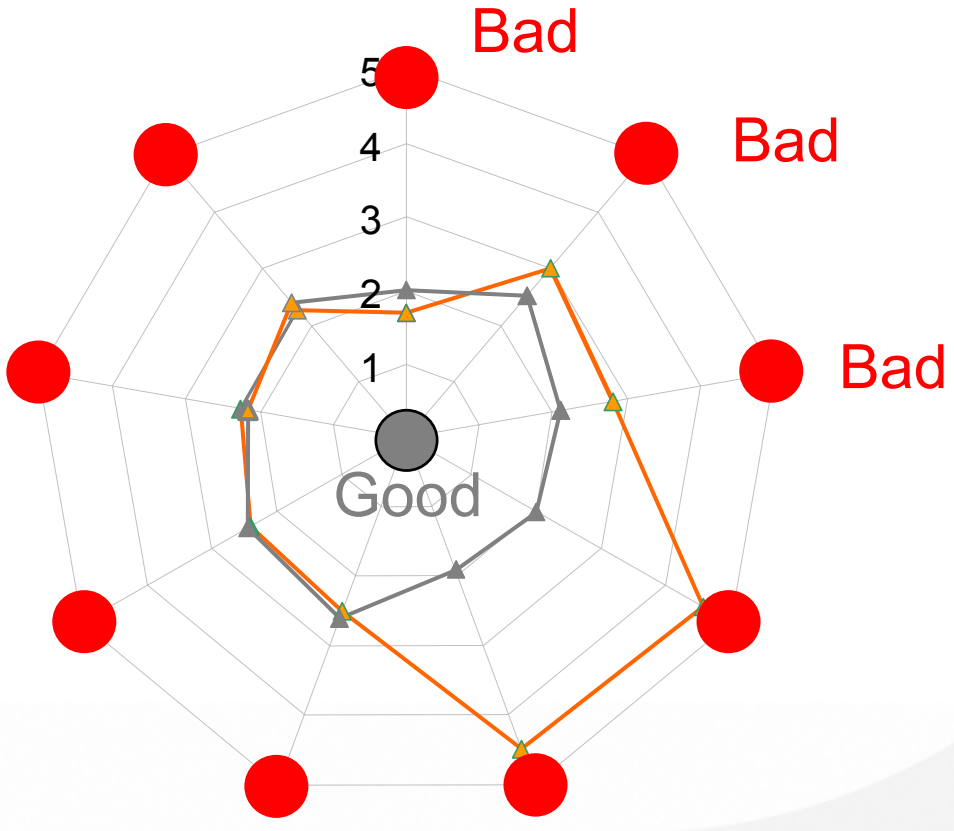


0 : Good / 5 : Bad

C.T.P. printing quality index

- **Each printing quality criteria converted into index**
  - 0 = Very good
  - 5 = Very bad
  - 2 = Acceptability level





CTP's image analysis workflow

Specific Ink jet test form

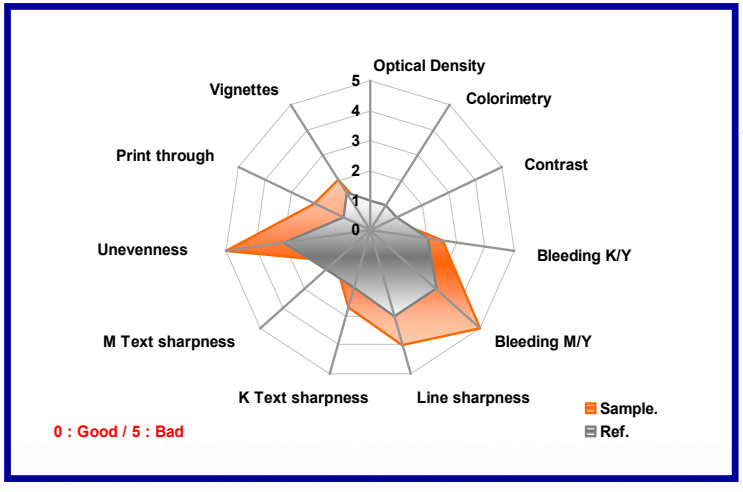
Set of Ink jet printers

Image Acquisition Scanner & opt.

Fitting image analysis treatments

Measurements

Human Evaluation scales



Report & Global quality Index

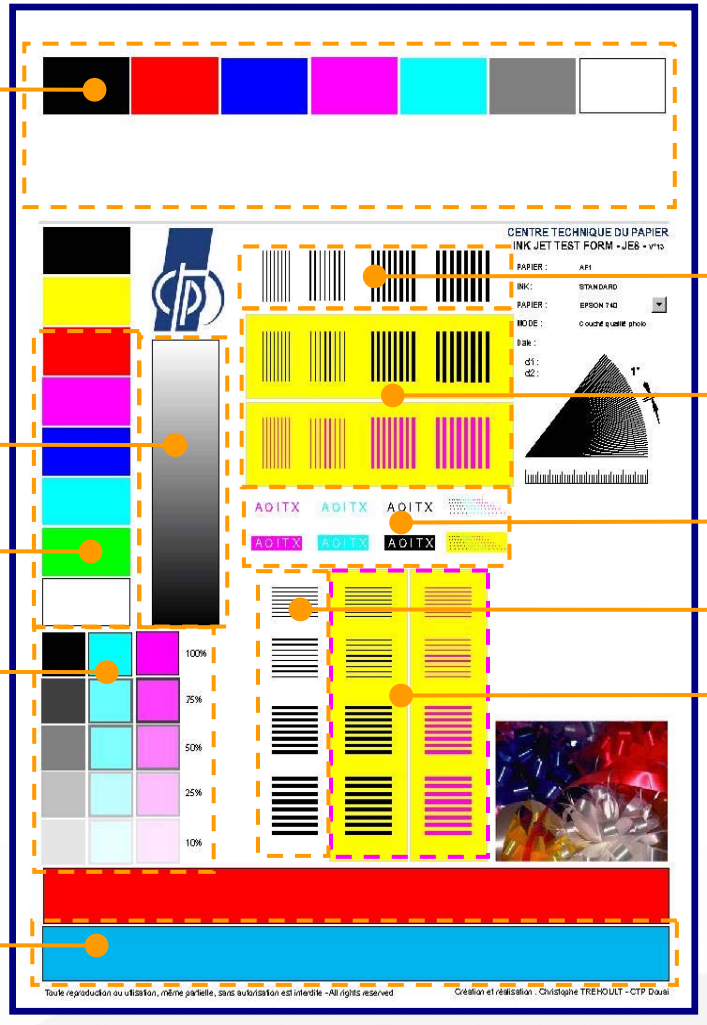
Comparison With CTP's Data base

Developments

- Gradation scales for each printing quality criterion
- Test form
- Printing parameters for each printer.
- Images acquisition & treatments.
- Correlation between evaluation scales & image analysis treatments

- **Ready for the future evolution**
- **Adaptated to the needs of the final user**

Printing test form by C.T.P.



Print through

Vignettes

Colorimetry

Optical density

Uneveness

Line sharpness

Bleeding

Text sharpness

Line sharpness

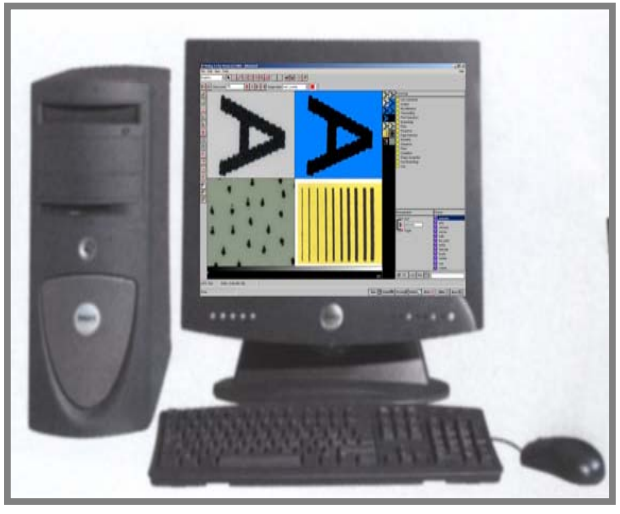
Bleeding

Scanning

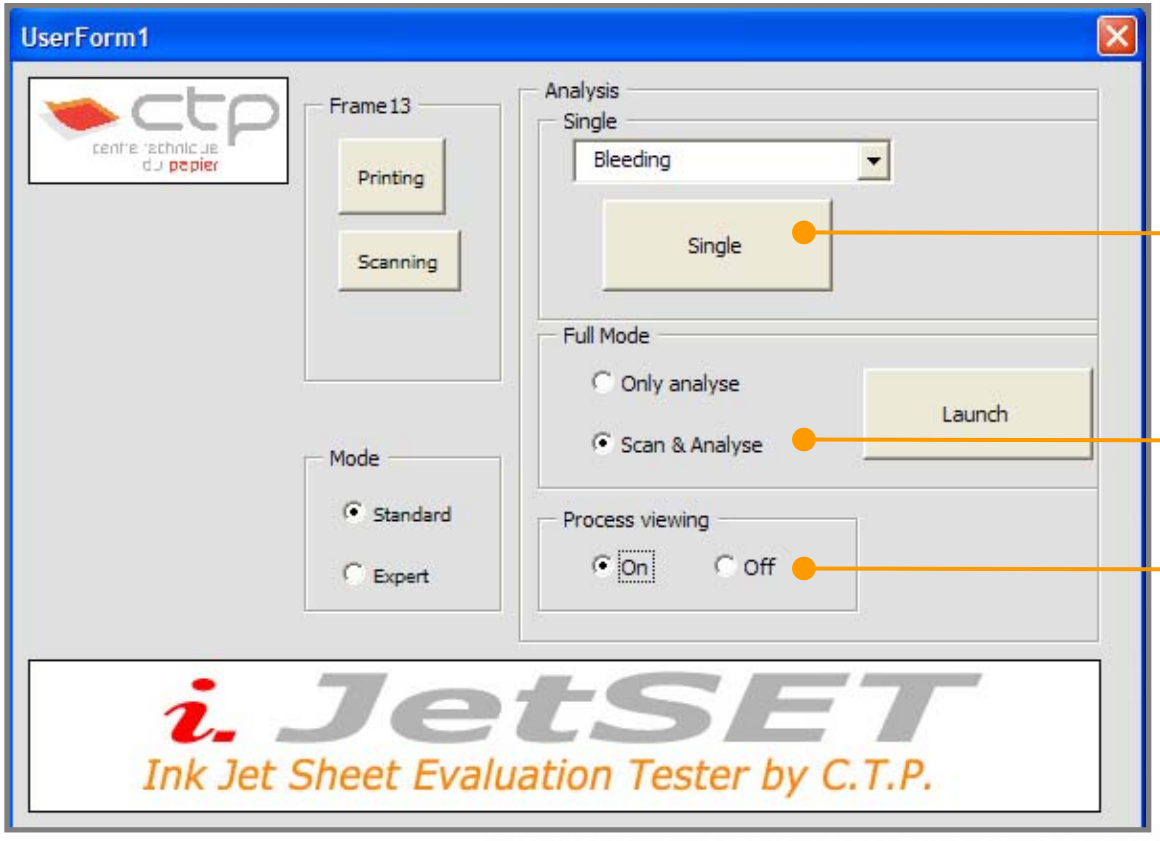
- Professional scanner 3000x3000 dpi.
- 48 bits color depth.
- Implementation of a script in the Twain driver.
- Reproducibility > 95%

Software

- **Choice : Visilog 6.5 (NOESIS) - RunTime Version**
- **Integrated system**
  - Driving of all the devices trough a stand alone application
    - ✓ Acquisition & archiving images
    - ✓ Interactive Measure
    - ✓ Treatment
    - ✓ Calibration



View from the main application form

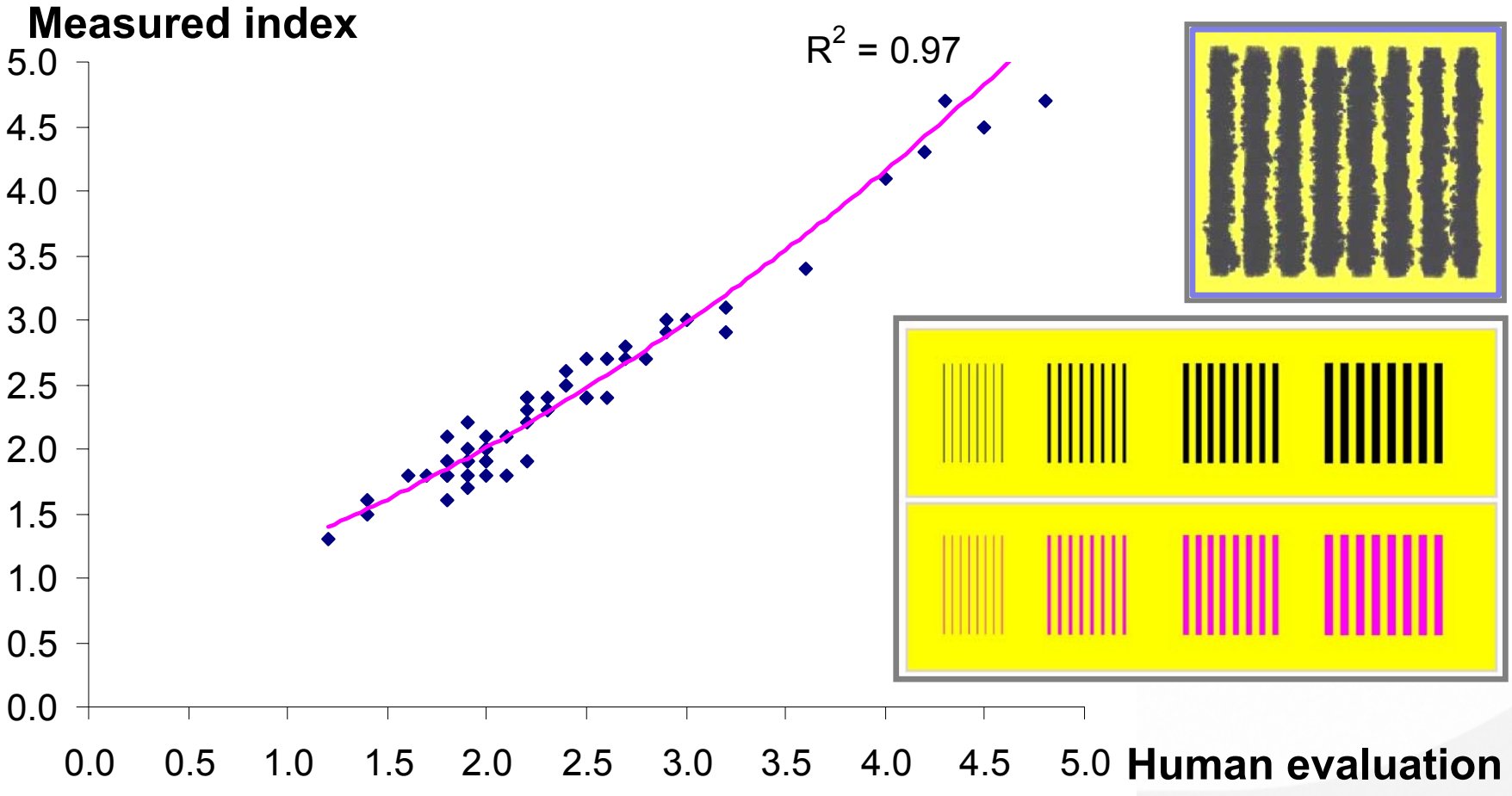


Single analysis

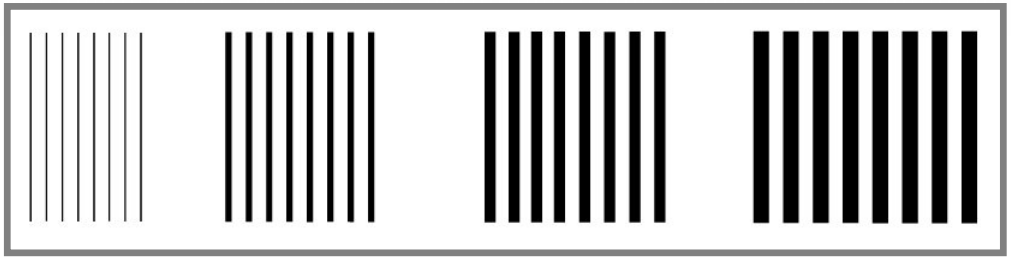
Complete automation of full process

Quicken processing

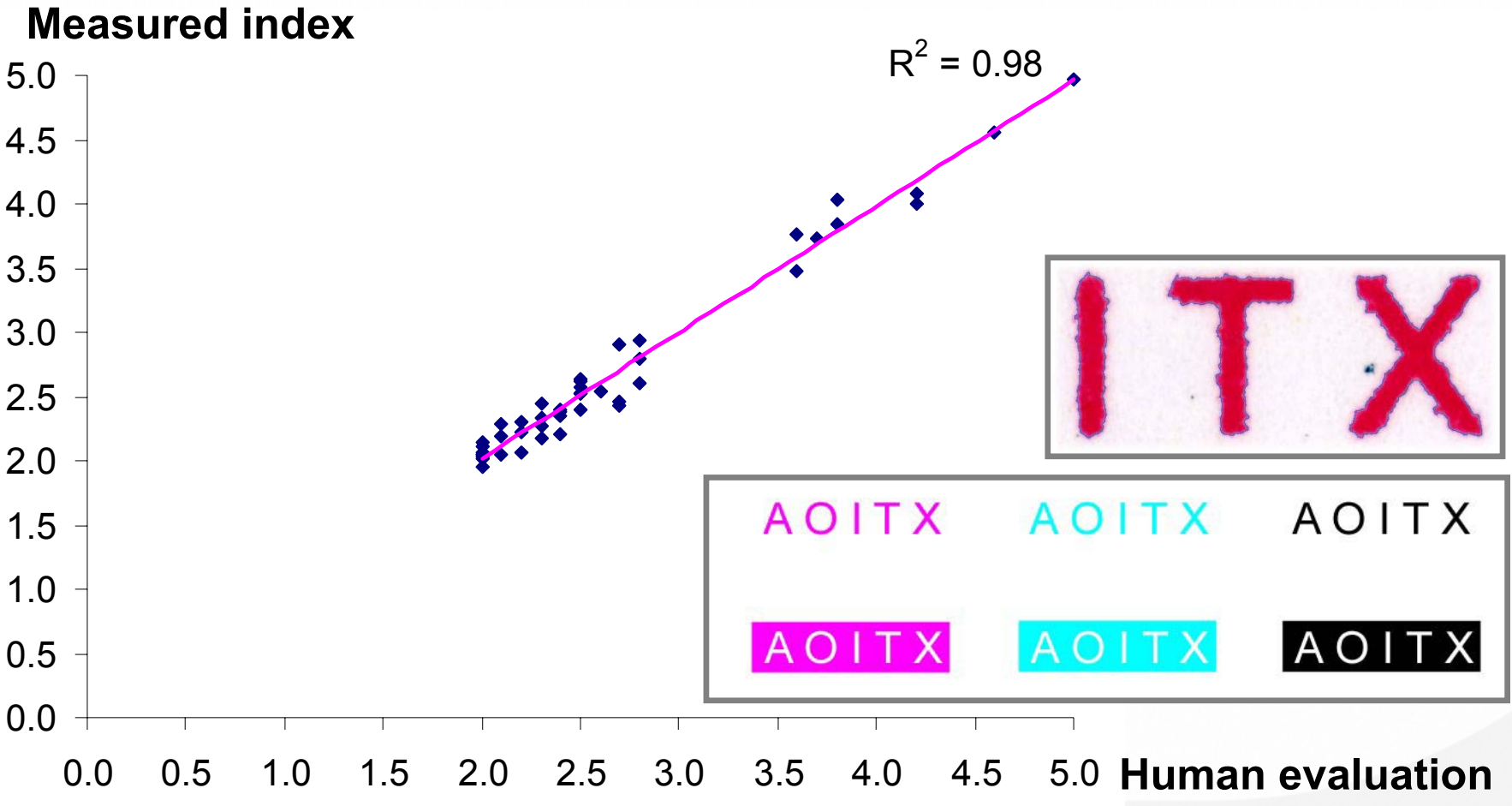
Subjective assesment
Bleeding



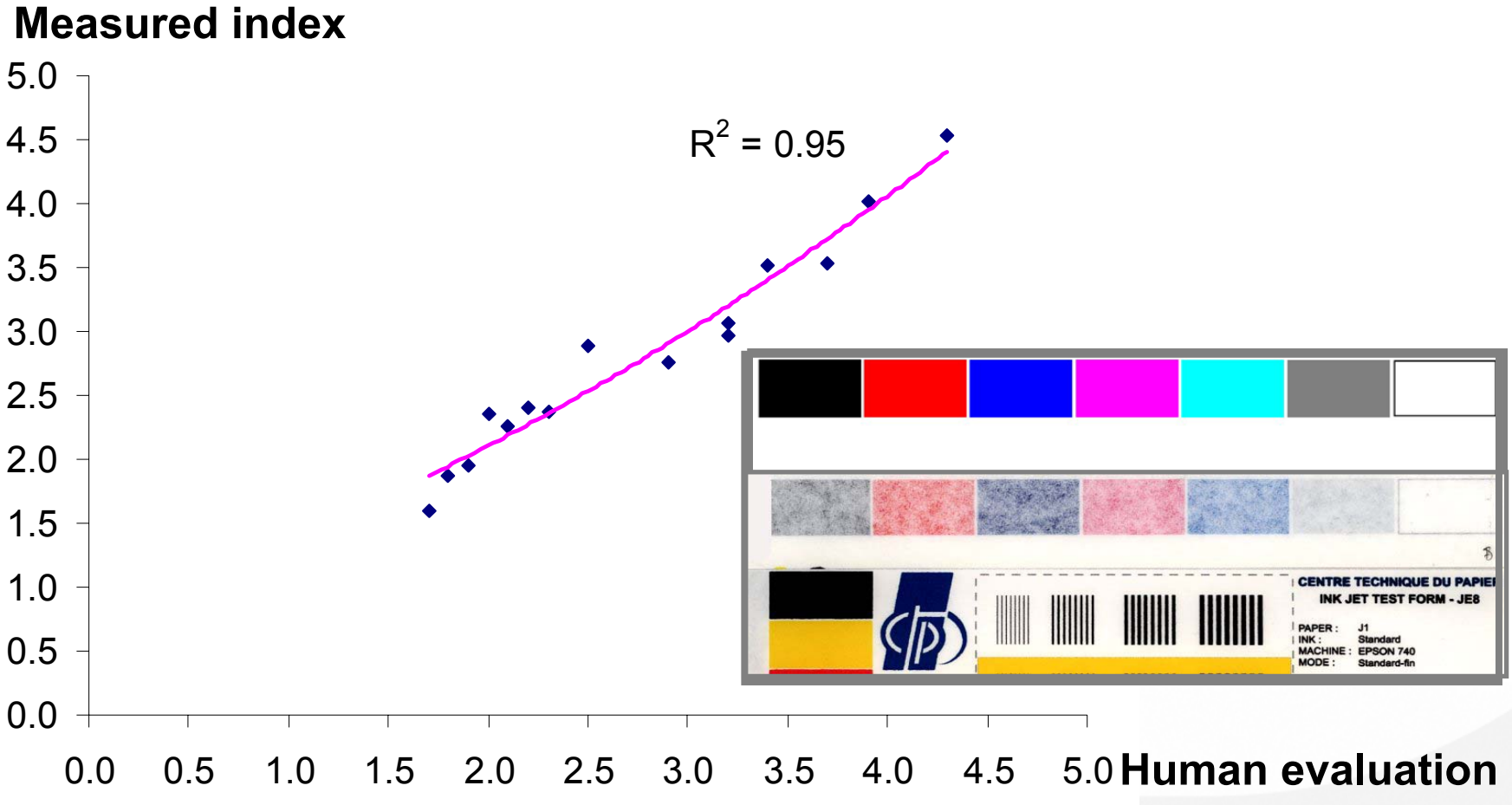
Subjective assessment
Line sharpness



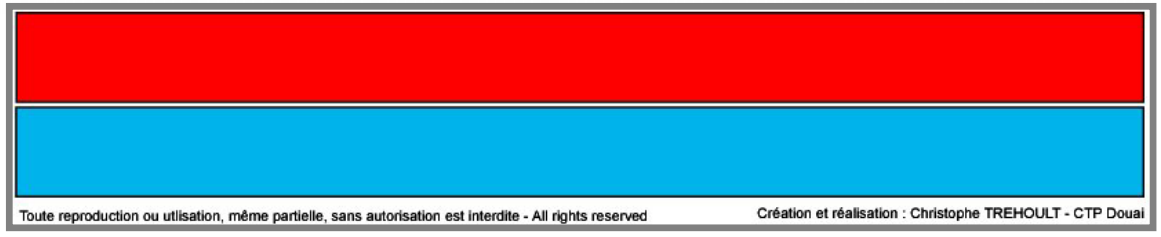
Subjective assessment
Text quality

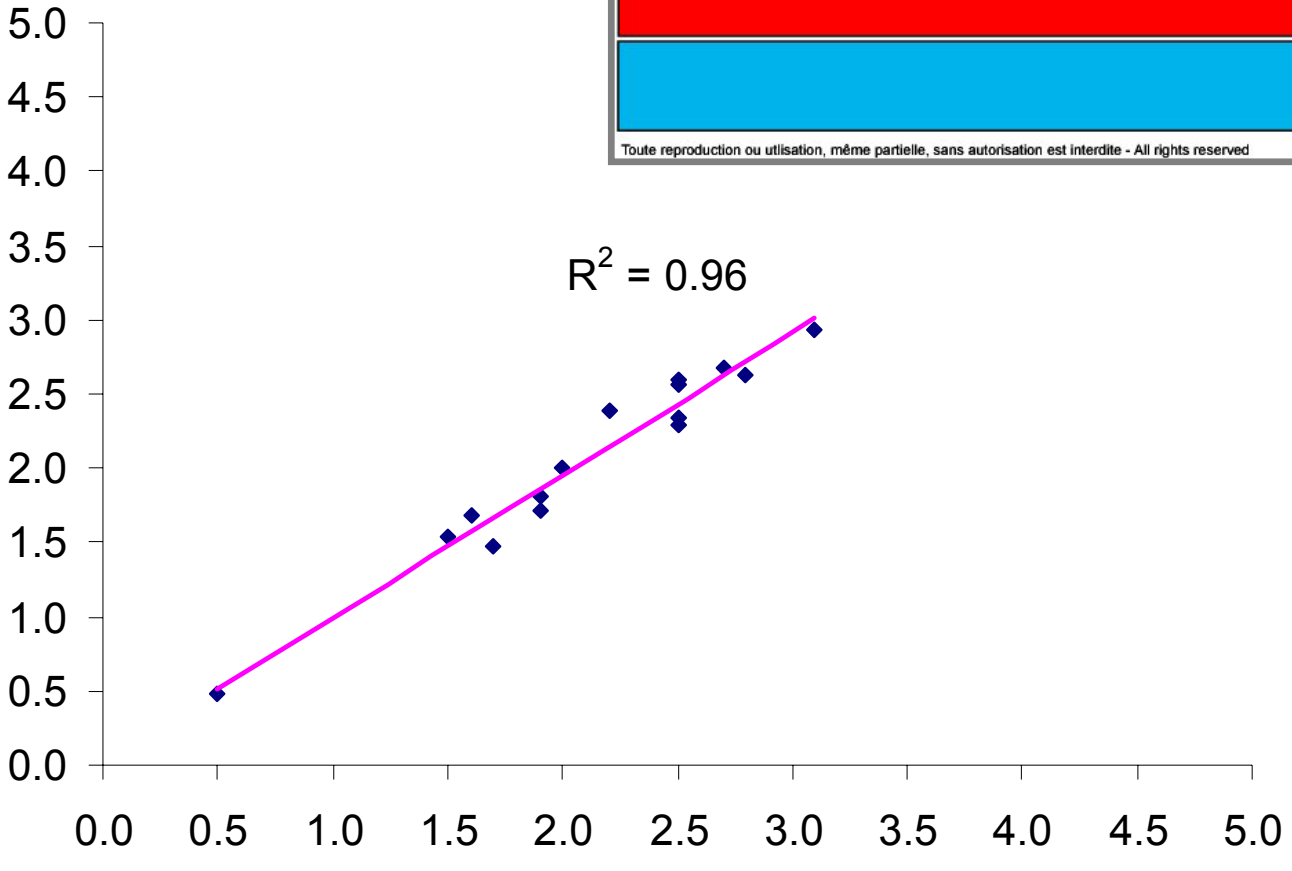


Subjective assesment
Print through

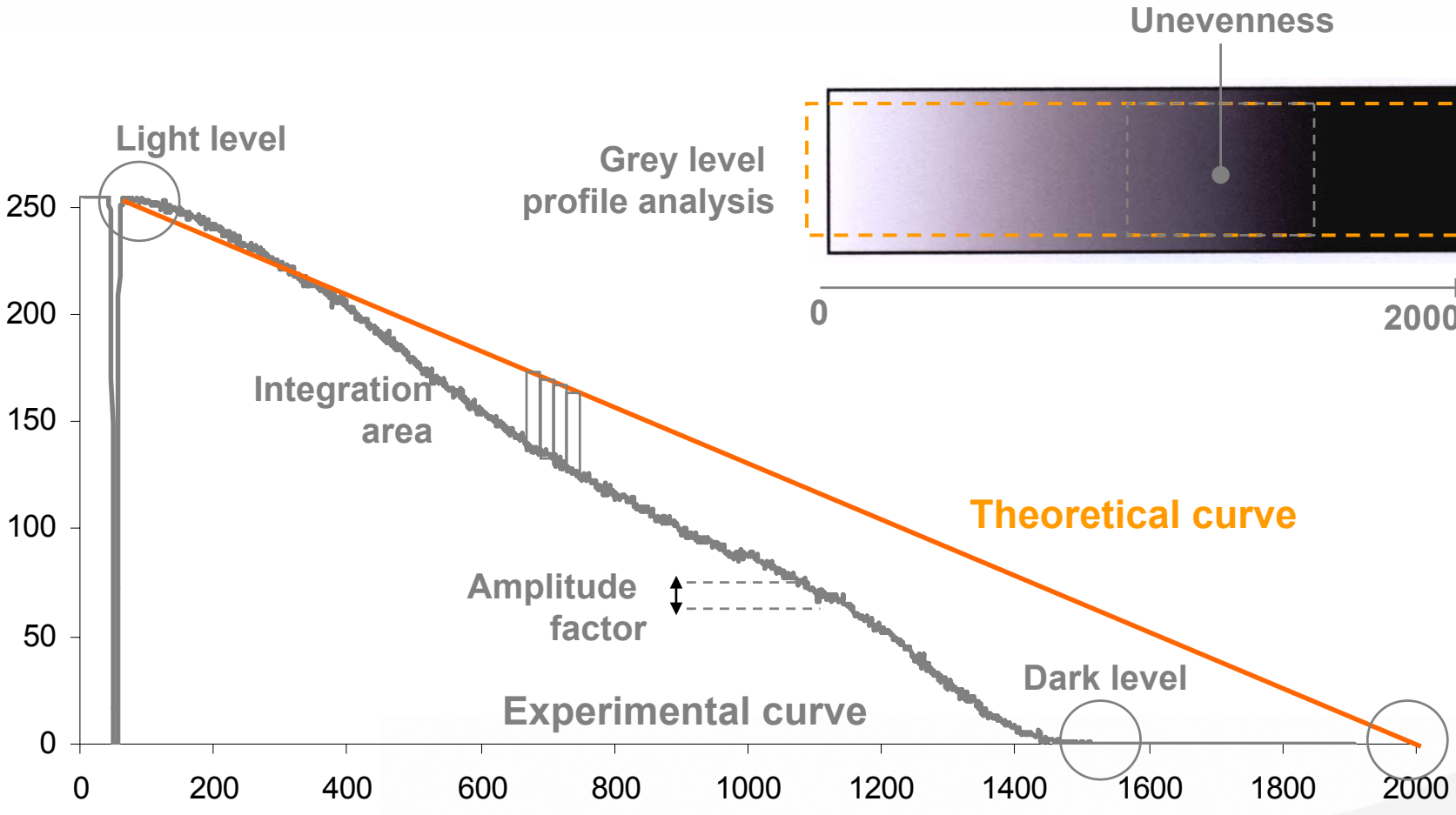


Subjective assesment
Unevenness

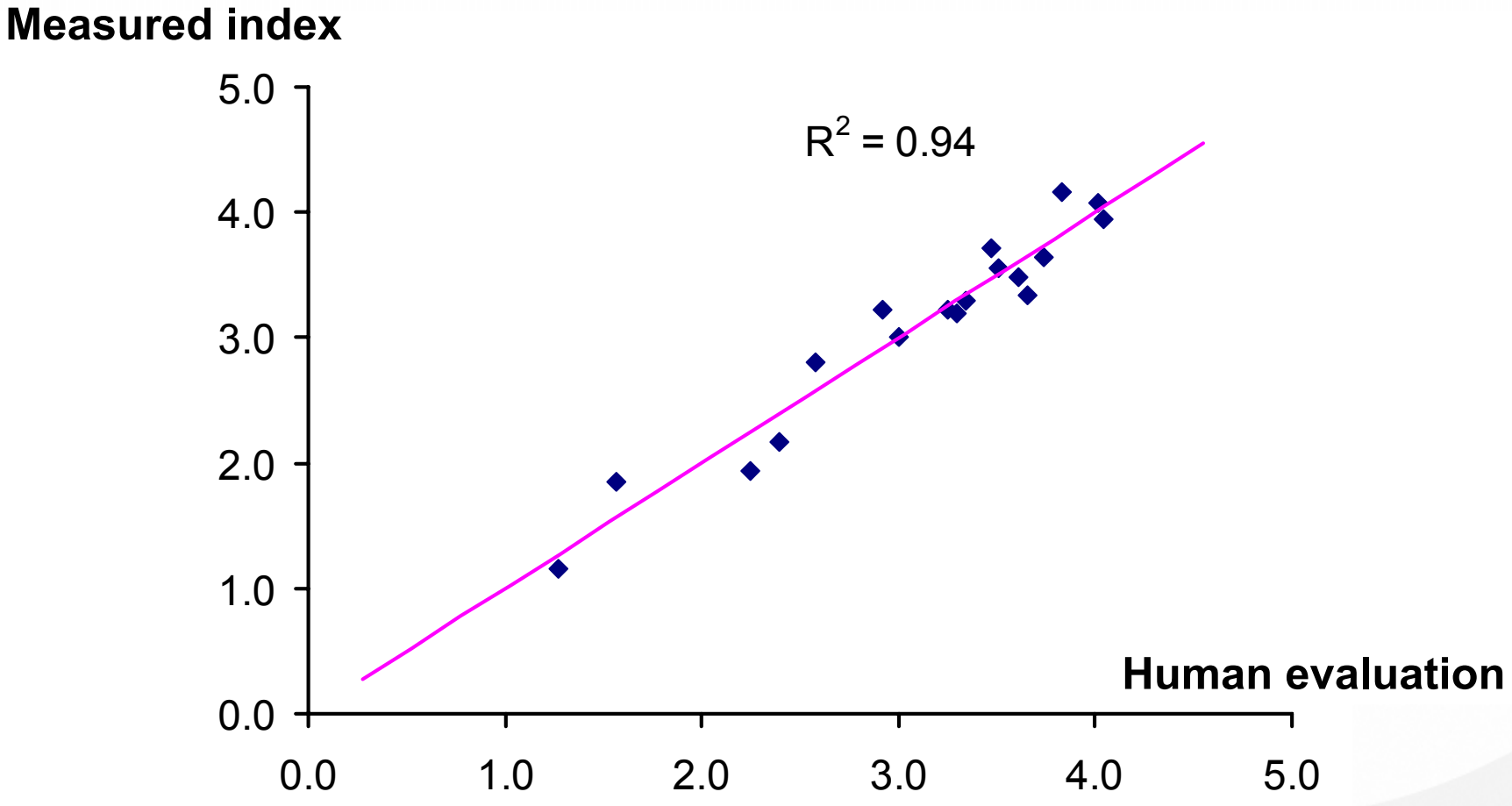




Subjective assessment
Vignettes continuity

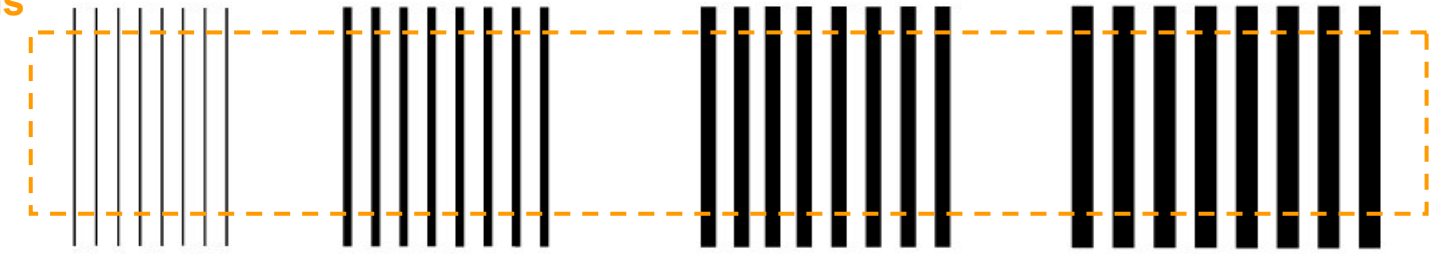


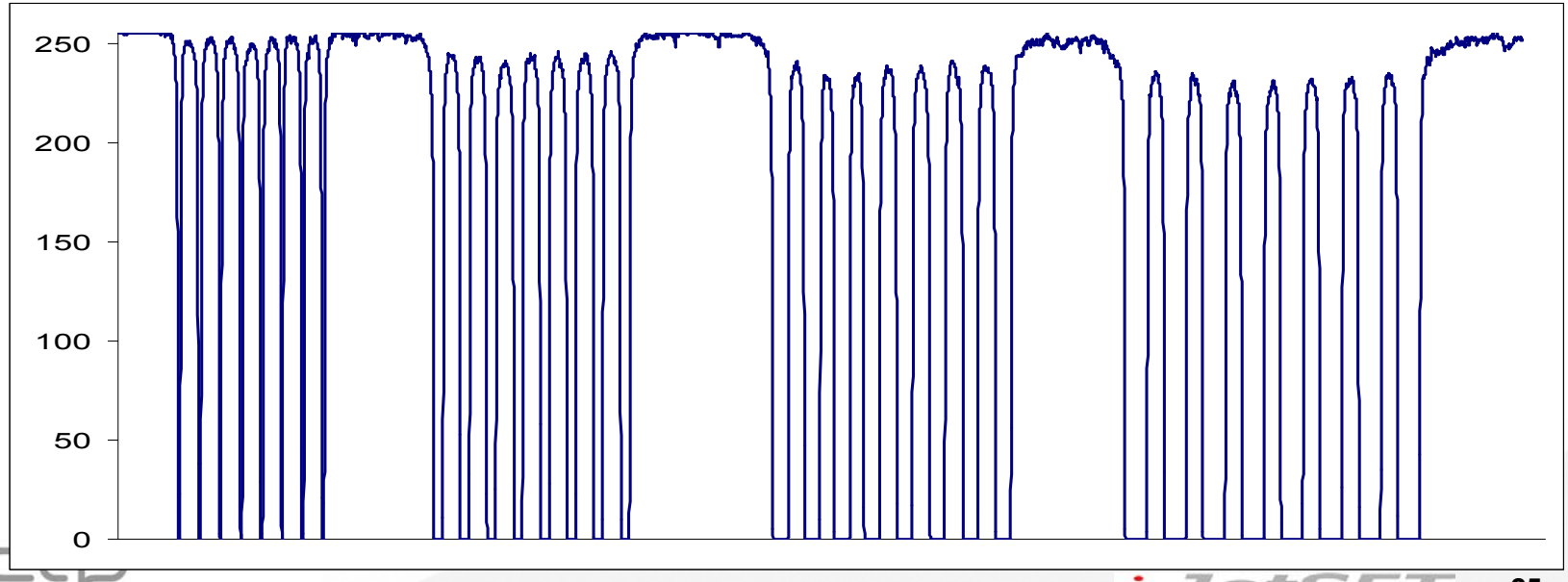
Vignettes continuity



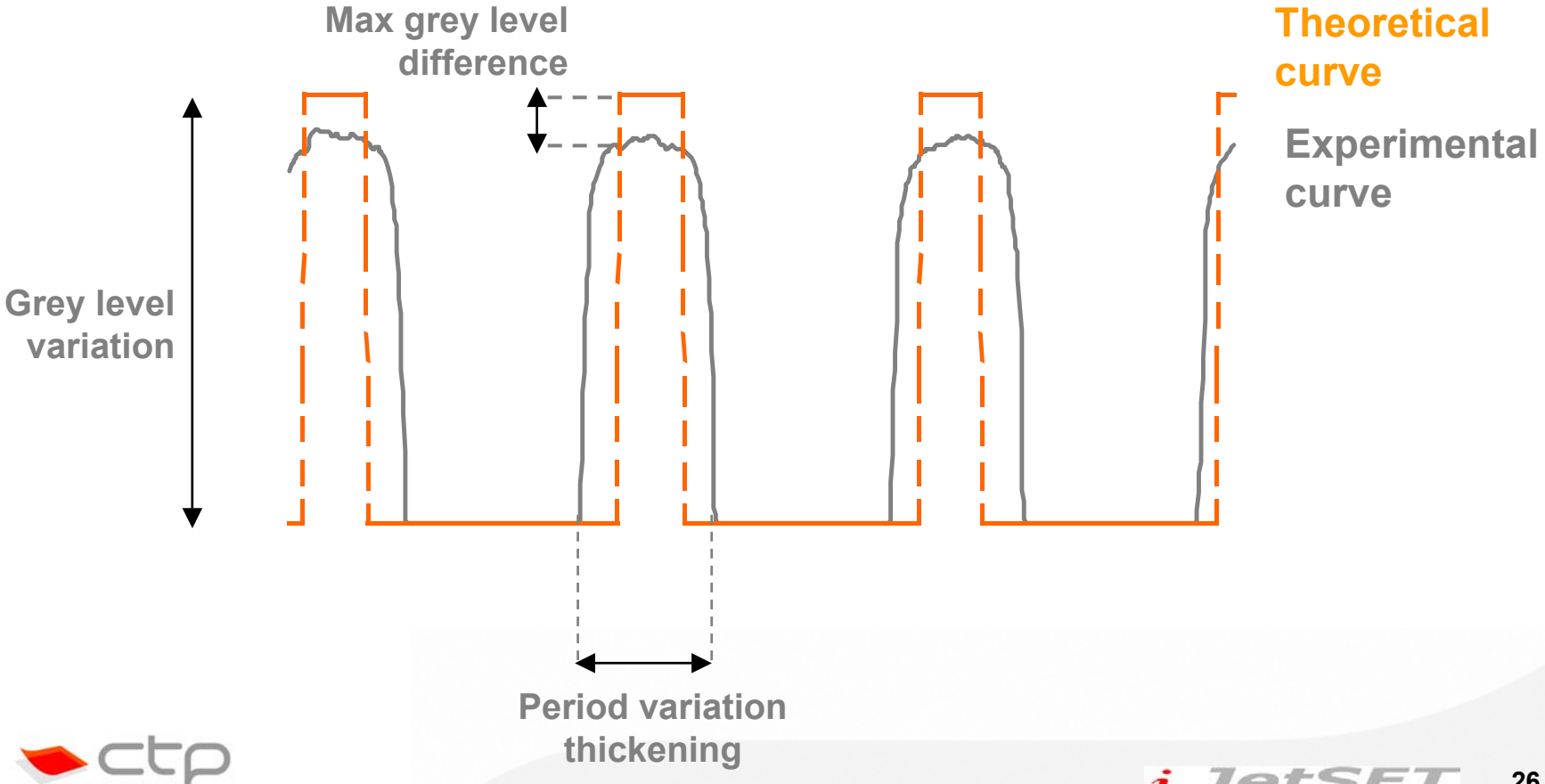
Contrast

Grey level profile analysis



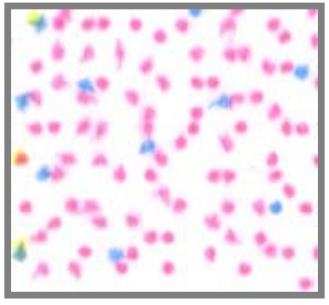


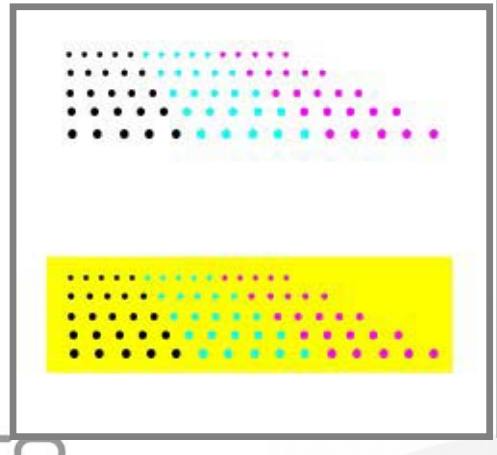
Contrast - details



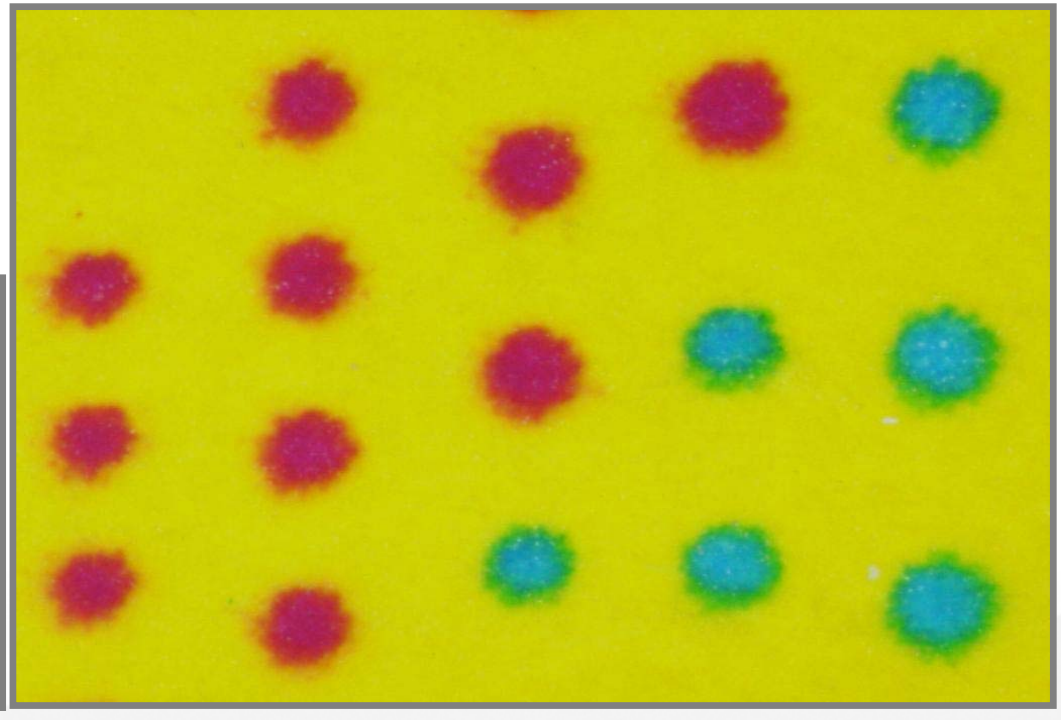
Dot shapes scanning

Scanner maximum magnification on original print dots

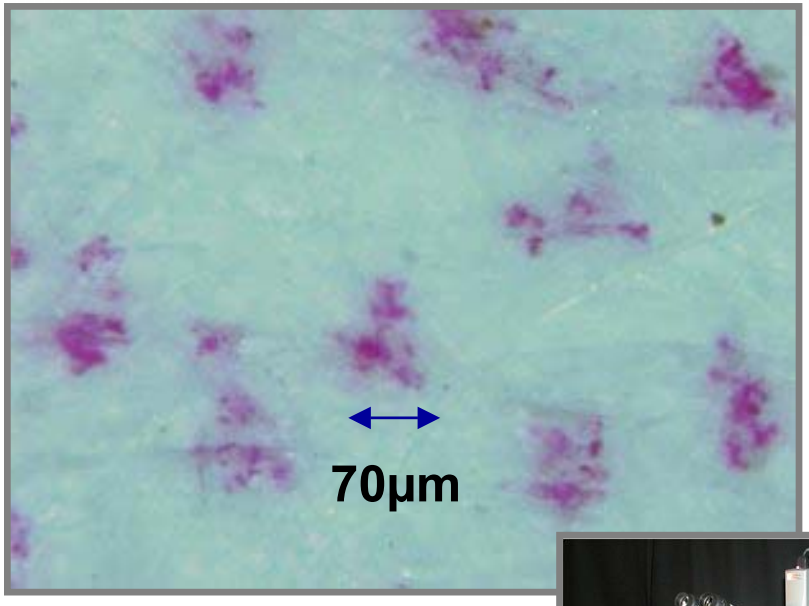


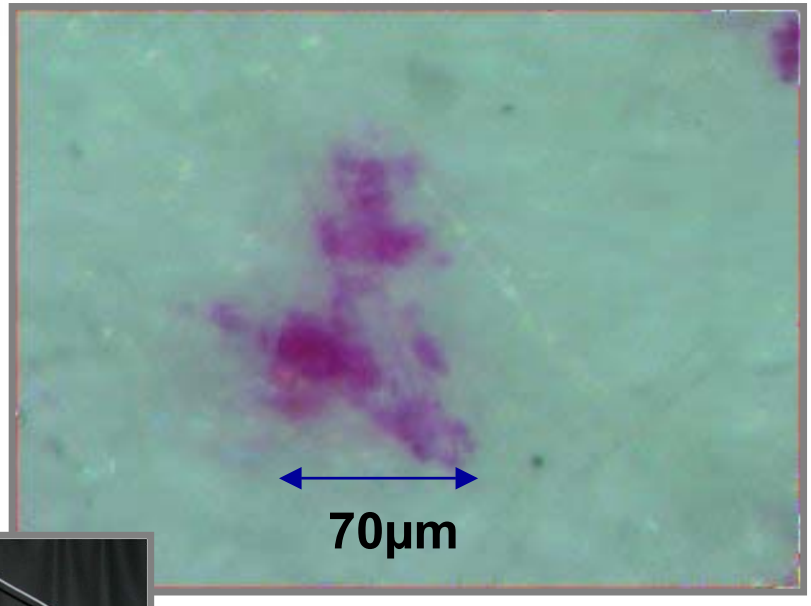


Clustering print dots



Stereomicrospope print dots
Image acquiring

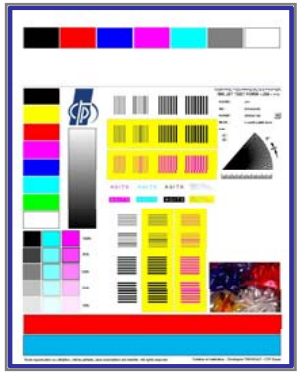


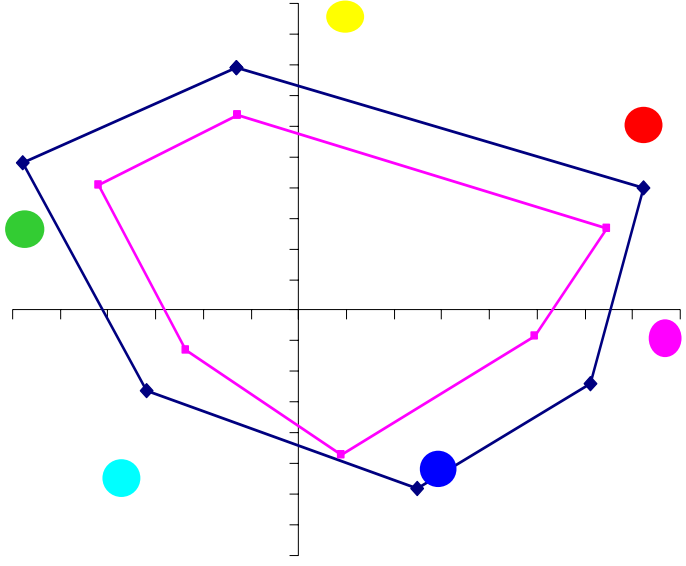


Color measurement

- Connected and interfaced in the software
  - ✓Spectroscan
  - ✓Spectrolino
  - ✓Eye-one *(USB connected)*
- Black O.D. and gradation curve values translated into measurement indexes (0 to 5)

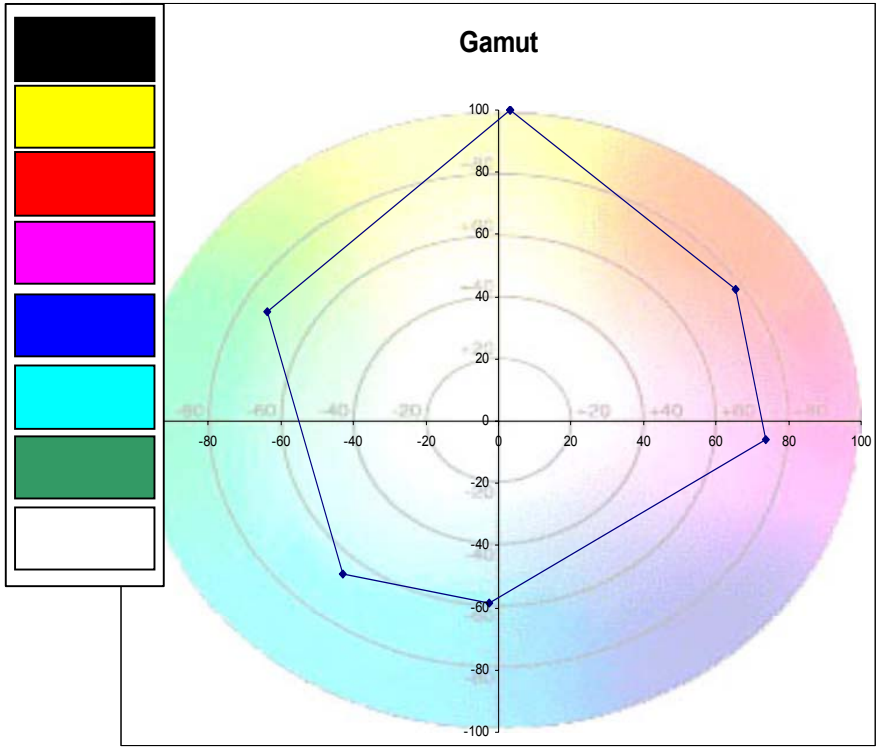
Gamut evaluation

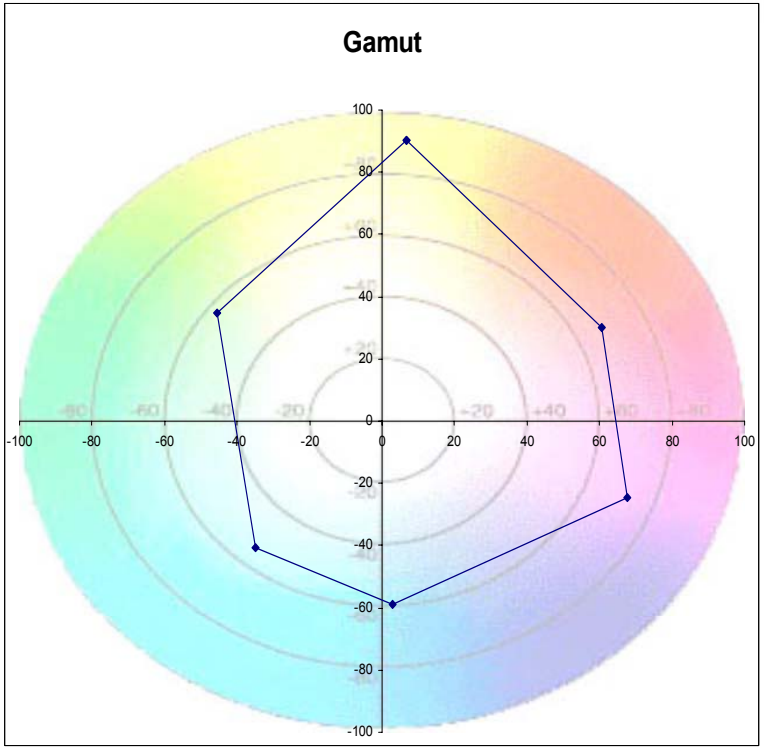




Gamut curve integrated to get one measurement index

Colorimetry (Gamut)





HP815c paper 05-A1

HP8250 paper 05-A1

Larger gamut = Better possibility for color reproduction

Ink amount linked to gamut area

Images evaluation

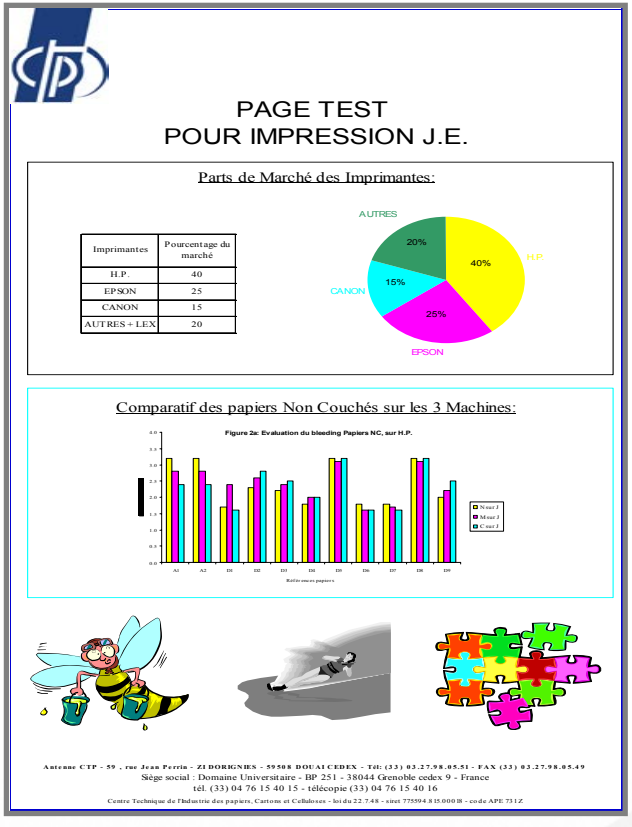
Ribbon

Low Res.

Alien

High Res.

SOHO



Standard mode

Result synthesis form

ctp centre technique du papier

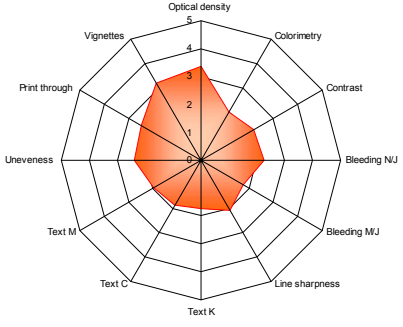
i.JetSET Ink Jet Sheet Evaluation Tester by C.T.P.

Results file 1/2

Date: 07/09/07
Paper: 070215-05a — **Printing mode**
Source: — HP 8250
Type:
Grammage:
Soft V°: 2.0
Scanner: Epson V700 — **Test form:** FTJEBV°13

Criteria		Index
Optical density		3.37
Colorimetry		2.0
Contrast		2.16
Bleeding N/J		2.27
Bleeding M/J		1.74
Line sharpness		2.09
Text	K	1.73
	C	1.86
	M	1.94
Uneveness		2.40
Print through		2.48
Vignettes		3.20
Mean		2.3

	L	a	b	Delta E
	87	3	70	21.7
	54	50	18	42.9
	51	62	-19	13.1
	44	3	-47	10.8
	63	-28	-46	32.2
	62	-42	24	26.8
	87	3	70	
Gloss		Blank	Black	Gain
Ink setting		5"	60"	
Image human evaluation				

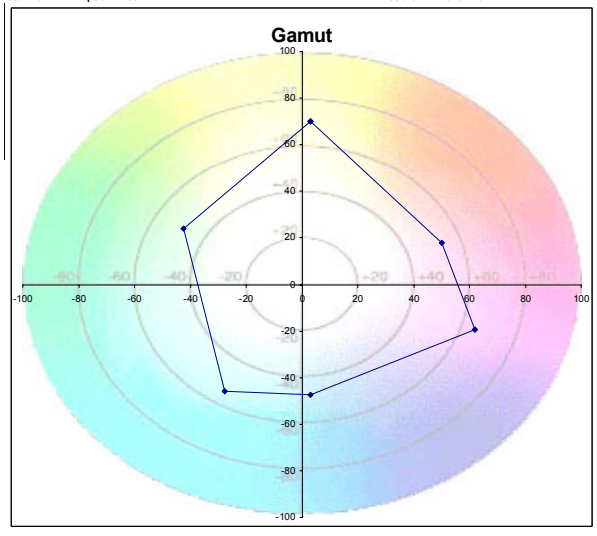


ctp centre technique du papier

i.JetSET Ink Jet Sheet Evaluation Tester by C.T.P.

Results file 2/2

Date: 07/09/07
Paper: 070215-05a — **Printing mode**
Source:
Type:
Grammage: — **Gamut measure : EyeOne**
Soft V°: 2.0
Scanner: Epson V700 — **Test form:** FTJEBV°13



Analysis delay for one printer

- Printing — 2 to 5 min
- Scannerisation — 5 min
- Images treatments — 5 min

- Total — 12 to 15 min

Automated analysis delay
Interleaved treatments

Delay (Min)	Sample 1								
5	Printing		**Samp. 2**						
10	Scan		Print.	**Samp. 3**					
15	Treat		Scan.	Print.	**Samp. 4**				
20		**15**	Treat.	Scan.	Print.	**Samp. 5**			
25			**15**	Treat.	Scan.	Print.			
30				**15**	Treat.	Scan.			
35					**15**	Treat.			
35						**15**			

15 Min (First sample) + (n-1) x 5 Min

Follow-up of the system

- Printers & Medias evolution
  - ✓Technology.
  - ✓Resolution.
  - ✓Inks characteristics.
  - ✓Digital printing survey at C.T.P.
- Updates
- Calibration & control
- Training courses

Measures to be added

- Cockling of samples ☒
- Evaluation of ink setting ☒
- Evaluation of wallace test ☒
- Evaluation of rub test ☒
- Evaluation of water fastness ☒
- Evaluation of light fastness ☒

- Others processes
  - ✓ Xerography
  - ✓ Large format ink jet
  - ✓ Flexo, Rotogravure….

Conclusion

- **New technology for fast and reliable assessment of ink jet quality**
- **Ready to be adapted to the future evolution**
- **Visual assessment connected to image analysis**

- **Usefull for bench-marking, research and process control**

i. JetSET

Ink Jet Sheet Evaluation Tester by C.T.P.