ECRANPAPIEREDITER
EPE

Work Package 6

Delivrable 6.2

Co-funded by
the European Union

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•Valence

Institut Supérieur
des Arts et Métiers
de Sfax

GRENOBLE INP UGA Pagora

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HEXAGONE Scène Nationale

EPE - Work Package#6

Delivrable 6.1

Pagora Prototyping Workshop#1

Participants

Pagora

Professors:

- Lionel Chagas
- Nadège Bruas

Students

- BAFOU Mélissa
- BAZ Rayane
- CHERFAOUI Zaky
- DEBENATH Lorène
- DIEMERT Nicolas
- GRENON Joshuah
- KERAMOAL Bastien
- PIEDALLU Coralie
- VAUTRIN Lucie

IzmirEko VCD

Professors:

- Daniele Savasta

Students

- Gözde Naz Terzi
- Oguz Ülgen Tung
- Muzafer Demireva

Esad Valence

Professors:

- Dominique Cunin
- Raphaël Bottura
- Romain Laurent

Students:

- Louison Penvern (Master Graphic Design 1st year)
- Hugo Lopez (Master Graphic Design 1st year)
- Andrea Kevorkian (Master Graphic Design 1st year)
- Seyedhossein Mousavi (Master Graphic Design 1st year)
- Mathis Curcio (Master Graphic Design 1st year)

Projects and Organization

Monday 9th of December

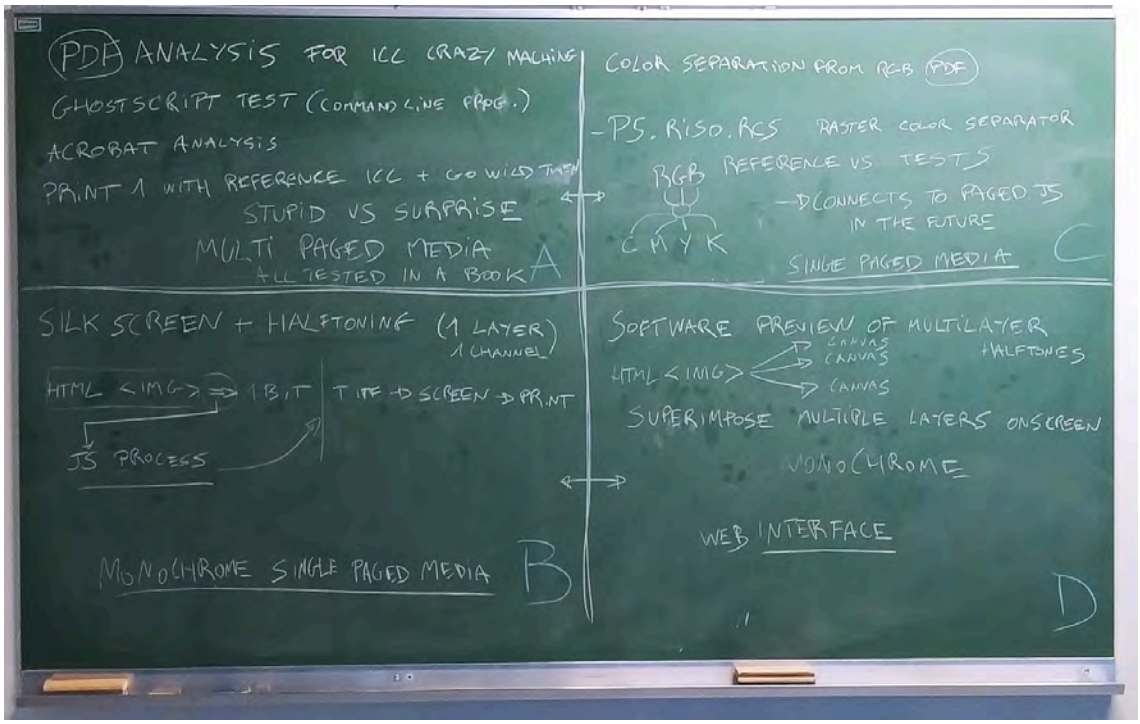
After a general introduction by Dominique Cunin, students from the Pagora engineering school presented their areas of study, under the supervision of professor Lionel Chagas. 2 differents keynote were given, the first one about color management and the second one about screening (rastering) in printing systems. To conclude the morning, the whole team discovered Pagora's facilities, including the impressing paper making workshop. In the afternoon, an overview of the content of a whole semester's course about color perception and characterization processes were given by Anne Blayo, head of the LGP2 laboratory (Laboratory of process engineering for biorefinery, bio-based materials and functional printing). This clarified the relationship between the human eye structure analysis driven by scientist in the 19th and 20th century, and its mathematical theorization to build color space descriptions systems still used today. We concluded with a presentation of Raphael Bottura's resources on existing web technologies for raster management and colour layer separation.

Tuesday 10th of December

To dive inside the engineering technics mastered by Pagora's team, Lionel Chagas proposed to calibrate a printer's ICC profiles by using their ususal methodology.

ICC profiles (International Color Consortium profiles) are standardized digital files that help manage color consistency across different devices like monitors, printers, and cameras. They ensure that colors appear as accurately as possible by mapping device-specific color characteristics to a common color space, such as XYZ or Lab. By using ICC profiles, designers can maintain color fidelity across different screens and print outputs.

The 3 main themes that was proposed and the new input students got in the previous day was too fresh for them to determine a precise project to engage in. To give some new impulsion and some leading motivation, the leading professors designed 4 independant groups, with the goal to work on 4 seperated experimental tasks :



The 4 projects then got their titles :

1. Crazy ICC Machine
2. Halftoning - Silkscreen
3. Halftoning - Color Separation (SEPA)
4. Software for Color Halftoning Multilayer

Wednesday 11th-Friday 13th of December

The 4 groups worked on their respective project to acheive the results they defined. A public presentation of the results was held on this occasion.

Crazy ICC Machine

Hossein Mousani (Esad-V), Ema Lovrić (FGA), Bastien Keramoal (Pagora), Joshuah Grenon (Pagora), Zaky Cherfaoui (Pagora)

Crazy ICC Machine started out with the particular idea of having an ICC profile whose behaviour is not predictable, as if when assigning new values to the printing machine, the calculations were acting on its own. With this in mind, the group examined GhostScript, LittleCms, Pillow, etc. to find out how the ICC profiles files are written, and how it acted.

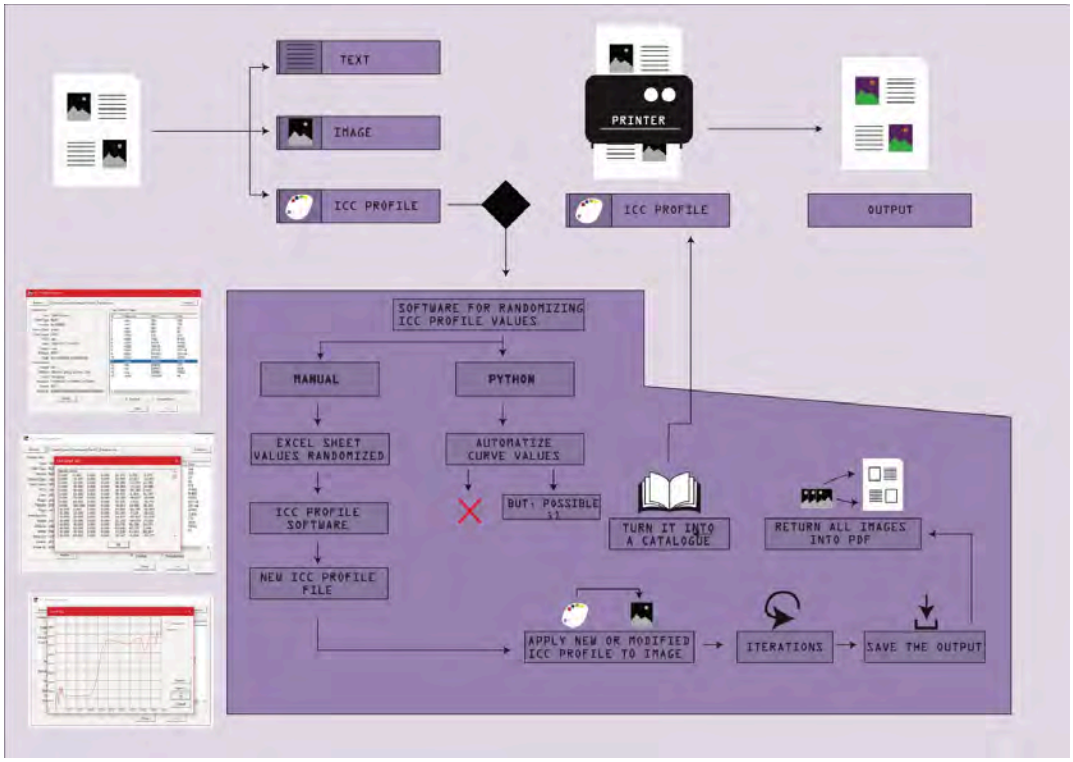
As a quick reminder, ICC profiles are digital files that encapsulates the description of the relationship between multiple devices color spaces. For example, from digital camera to display screen, a variety of light management electronics are engaged to reproduce colors : the light sensible sensor in the camera (i.e CCD sensor), the file that will keep the color information for each pixels from this sensor, then the display that will be used to view it on another device (i.e a computer). ICC profiles have been invented to keep track of the accuracy of this color reproduction chain between devices. It is important to note that for printing devices, the informations necessary to get the highest accuracy includes the paper type and even some ink characteristics. The math used to verify the accuracy of the color reproduction gives a precise value of the distance between to original color and the one of the destination device (whether display of print), called delta E (ΔE), which is the combination of the distance between each value of the input color space and the destination one with the L*a*b* system. A value higher than 3 makes consider the conversion a failure, in other words, the output colors are not accurate enough.

The « crazy » part of the machine this project aimed at produce was the ignore completely this standard usage of ICC profile and to « reverse » it by randomizing the values that are used in the correspondance table encoded in the profile. What we learnt is that, even if ICC profiles are widely used in the graphic industries, profiles themselves can be difficult to generate and are absolutely required for the calibration and the characterization of the devices used in the graphical chain. There are no « easy » way to manage and, mostly, to create ICC profiles. The only open source software that can be found is LittleCMS, an ICC engine used in the industry and a library written in C langage. To use this library in custom made software requires high level computer programming skills that no

one in our team has. So various « hacks » were found to tinker with ICC profiles already existing to achieve very surprising (and interesting) results gathered in the booklet produced by the students.


Photo by Alexander Afanasyev
ΔL constant
Δa & Δb randomized
ΔE = 23,4
ΔE = 0,5
ΔE = 49,4
ΔL, Δa & Δb
are randomized


3D Modeling a crazy gamut
for Fogra 39L 300
JapanColor2011
Coated

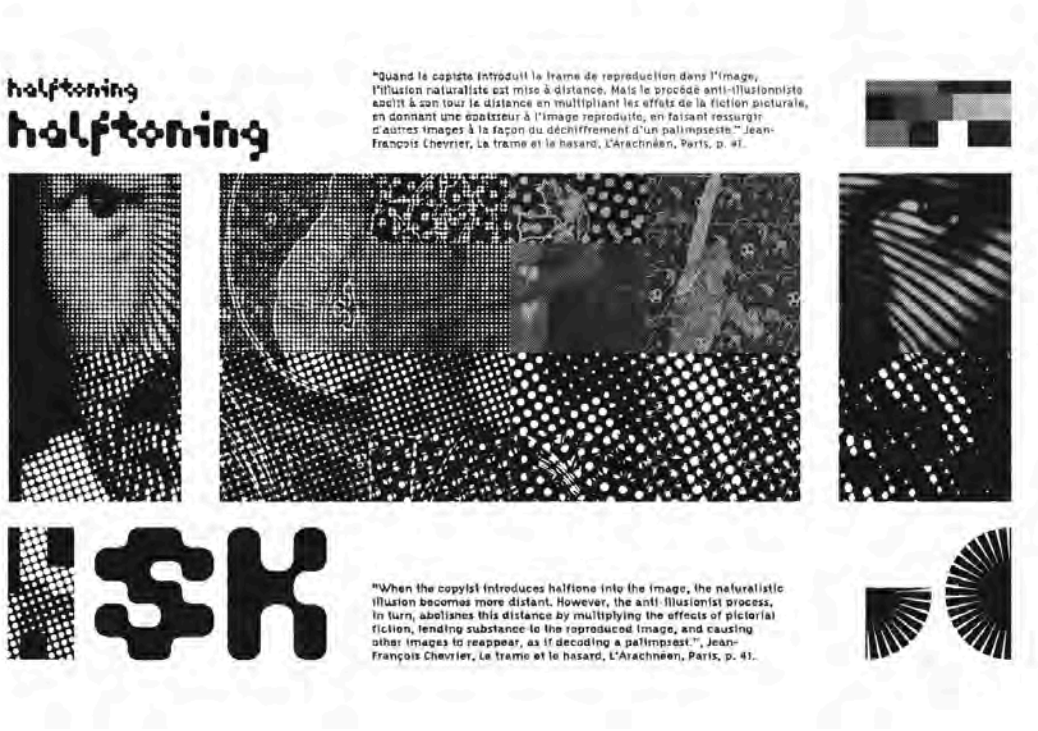

TEXT
IMAGE
ICC PROFILE
PRINTER
ICC PROFILE
OUTPUT
SOFTWARE FOR RANDOMIZING ICC PROFILE VALUES
MANUAL
PYTHON
EXCEL SHEET VALUES RANDOMIZED
AUTOMATIZE CURVE VALUES
ICC PROFILE SOFTWARE
BUT: POSSIBLE ??
NEW ICC PROFILE FILE
TURN IT INTO A CATALOGUE
RETURN ALL IMAGES INTO PDF
APPLY NEW OR MODIFIED ICC PROFILE TO IMAGE
ITERATIONS
SAVE THE OUTPUT

Halftoning

Hugo Lopez (Esad-V), Rebeka Šćulac (FGA), Melissa Bafou (Pagora), Lorene Debenath (Pagora), Muzafer Demireva (Izmir Economic-VCD)

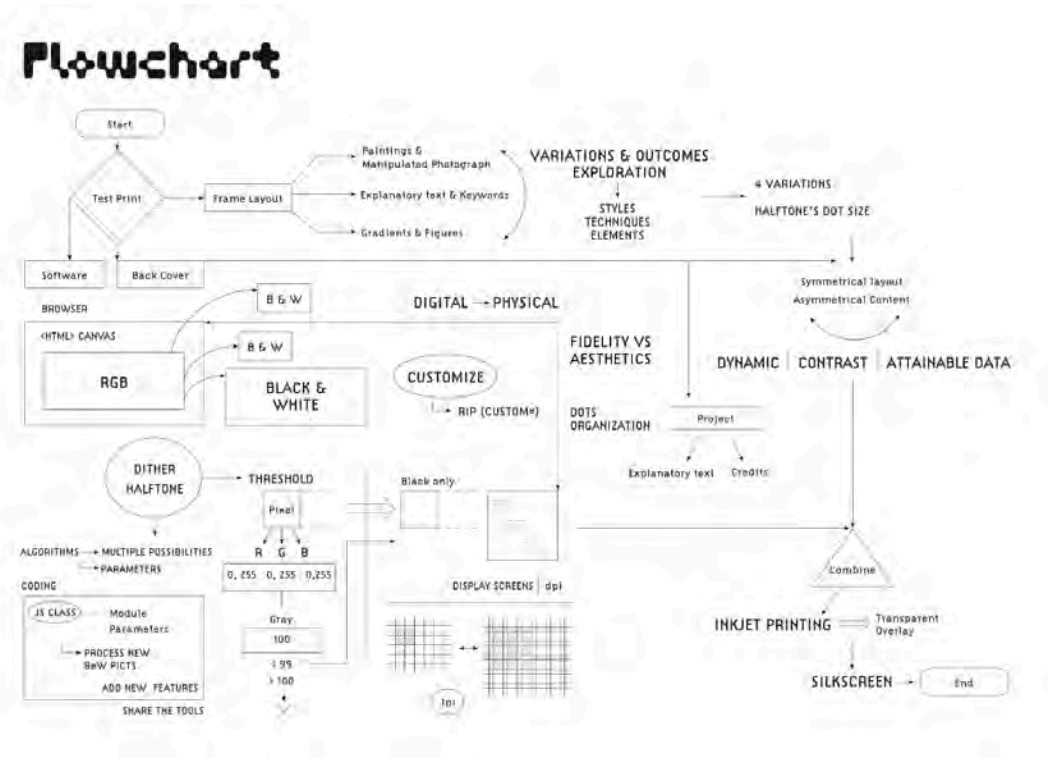
This group has developed a JavaScript web tool capable of rasterizing an input image, and then print it with silkscreen. With the precision of a webcam adapted to a powerful macro lens, they could take into account the mesh size of a frame selected beforehand for their future prints, and therefore calculate the size of one raster point of the software (a pixel) created before the workshop and managed by a member of the group.

The rasterizer has been made with the assistance of AI, as the code implementation of raster algorithms is widely documented for several decades. The global architecture of the software has been designed beforehand with the idea to facilitate the choice and parameters of the used rasterizer algorithm (simple class based structure in ES6). After multiple iterations to correct the chosen main algorithm, half-toning, to manage correctly every possible color shading configuration, it has been chosen to design a king of « color chart » with the combination of paper types and colors, and ink colors. The same A3 page has been printed multiple time to compose this « half-toning chart » like object, silkscreened on Pagora's devices that are usually used for printed electronics.



One particular point of this project methodology consisted in the comparaison between the home made half toning implementation and the one embedded in Photoshop. After several tests with various source images and settings, the group decided that their own implementation was more efficient than the one of Photoshop. The key point is that by implementing the algorithm by themselves, even with the help of an AI chatbot, they could grasp the technical details of the process and fine tune every part of it : point size and shape, spacing, rotation, linearity.

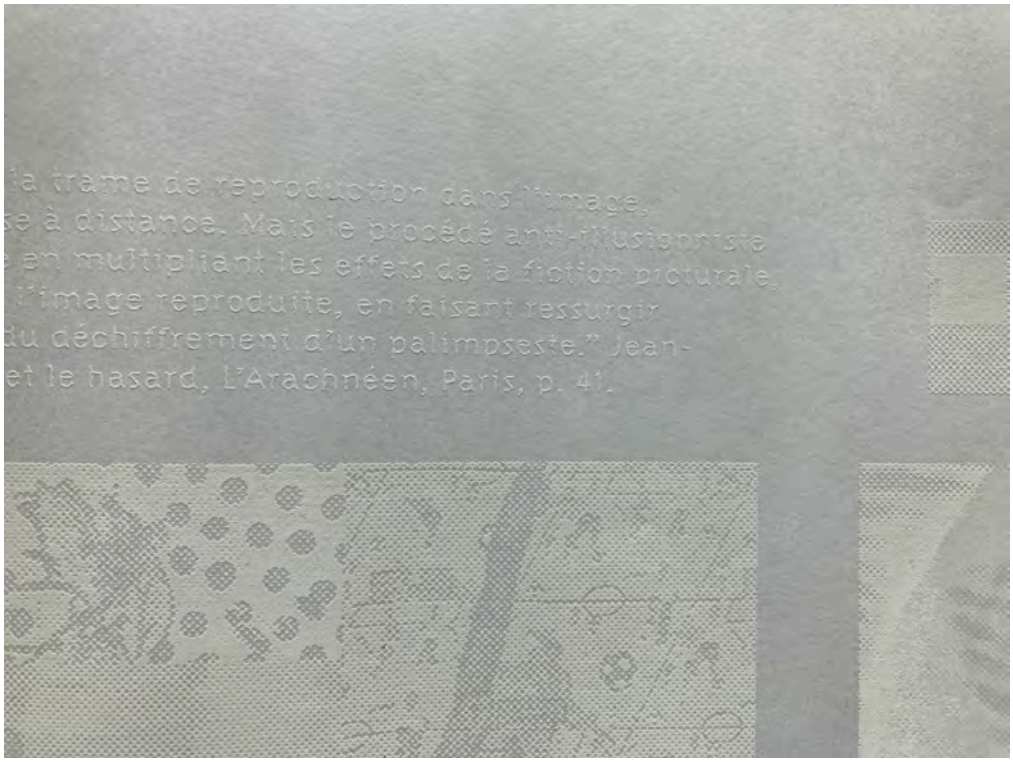
This gives us yet another proof of one of our main position in the EPE project : technical knowledges and skills are necessary to the work of the designer, as it stays the key to get enough liberty and power over the tools that are available to us for our creation practices. That's why designers and engineers should be able to work together, and this cooperation work can only be possible if each side makes the effort the understand the goals and methods of each other.


Flowchart
Start
Test Print
Frame Layout
Paintings & Manipulated Photograph
Explanatory text & Keywords
Gradients & Figures
VARIATIONS & OUTCOMES EXPLORATION
STYLES TECHNIQUES ELEMENTS
4 VARIATIONS
HALFTONE'S DOT SIZE
Software
Back Cover
Symmetrical layout
Asymmetrical Content
BROWSER
<HTML> CANVAS
RGB
B & W
B & W
BLACK & WHITE
DIGITAL → PHYSICAL
CUSTOMIZE
RIP (CUSTOM*)
FIDELITY VS AESTHETICS
DOTS ORGANIZATION
Project
Explanatory text
Credits
DYNAMIC | CONTRAST | ATTAINABLE DATA
DITHER HALFTONE
THRESHOLD
Pixel
R G B
0, 255 0, 255 0,255
Gray
100
< 99
> 100
Black only
DISPLAY SCREENS | dpi
ALGORITHMS → MULTIPLE POSSIBILITIES
→ PARAMETERS
CODING
JS CLASS
Module Parameters
→ PROCESS NEW BeW PICTS
ADD NEW FEATURES
SHARE THE TOOLS
Combine
INKJET PRINTING
Transparent Overlay
SILKSCREEN
End


halftoning
halftoning
$K


halftoning
halftoning
$K


8 LPI 305 DPI 20°
"When the copyist introduces hal
illusion becomes more distant. H
in turn, abolishes this distance by
fiction, lending substance to the
other images to reappear, as if d
François Chevrier, La trame et le h


la trame de reproduction dans l'image,
se à distance. Mais le procédé anti-illusionniste
en multipliant les effets de la fiction picturale,
l'image reproduite, en faisant ressurgir
du déchiffrement d'un palimpseste." Jean-
et le hasard, L'Arachnéen, Paris, p. 41.

LINK TO THE PROTOTYPE:

Source code : https://gitlab.com/esad-gv1/epe/projects/halftoning_silkscreen-pagora

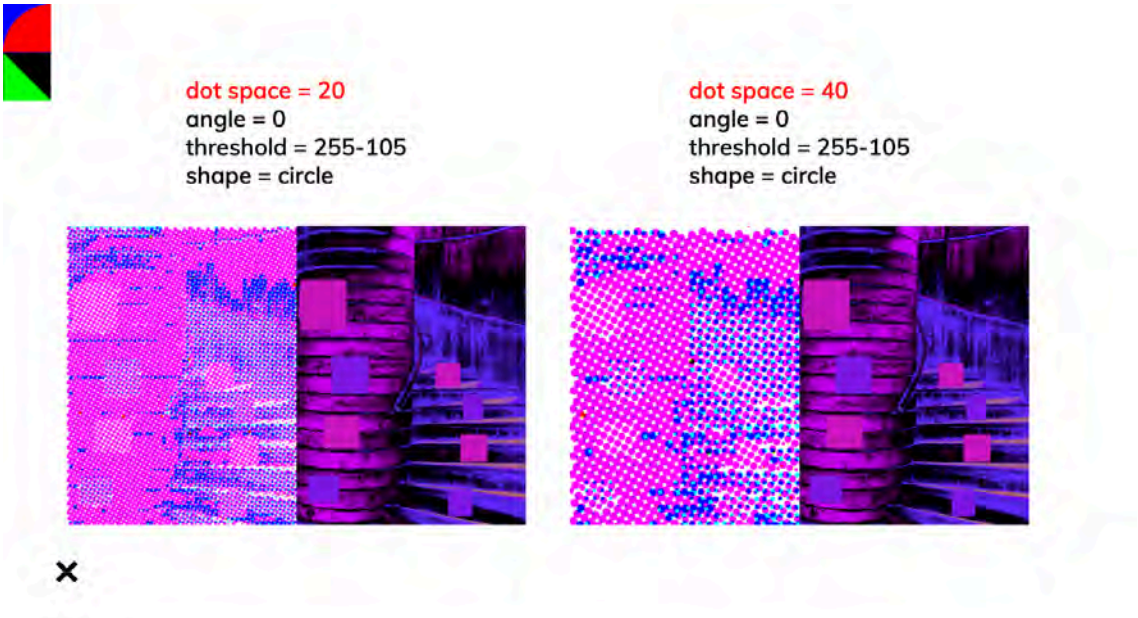
Live Demo : https://halftoning-silkscreen-pagora-8e75d3.gitlab.io

Color Separation-SEPA

Louison Penvern (Esad-V), Sara Iva Merlić (FGA), Katrin Veselinović (FGA), Coralie Piedallu (Pagora), Lucie Vautrin (Pagora), Gözde Naz Terzi (Izmir)

This group experimented with the colour separation used in monitors (RGB space) and their conversion for printing (CMYK space). Raphaël Bottura has created a tool based on the library P5.riso to enable the conversion parameters to be set precisely and freely. This tool generates four layers of Cyan, Magenta, Yellow and Black and allows the user to choose whether to superimpose the layers or present them separately. We chose to use photos of the Pagora school building as the subject of our proposal, which gives a thematic coherence. We played with the parameters that were available to us, the types of raster, the size of the dots, the value of the colours, and so on.

In order to modify the contrast of our source images, which were a bit too pale in the results obtained when the colours were separated, we started by using Photoshop. But two problems arose: we didn't all have Photoshop on our computers, and the types of manipulation we were considering weren't always consistent with each other.



We decided to take on the challenge of implementing a new function in the program that would enable colour to be processed directly, with the medium-term objective of imitating the gradient transfer curve mask available in Photoshop. This required us to understand the fundamental principles of P5.js, the JavaScript version of Processing, a programming tool dedicated to image creation. Some pre-implemented functions such as `tint()` proved useful, as did the ability to store matrices in memory `pop()` in order to apply processing to them before drawing them again `push()`. We didn't manage to get very far, but the discovery was enlightening and puts into perspective the importance of software like Photoshop, which can be dispensed with depending on the project you're working on.


COLOR
SEPARATION

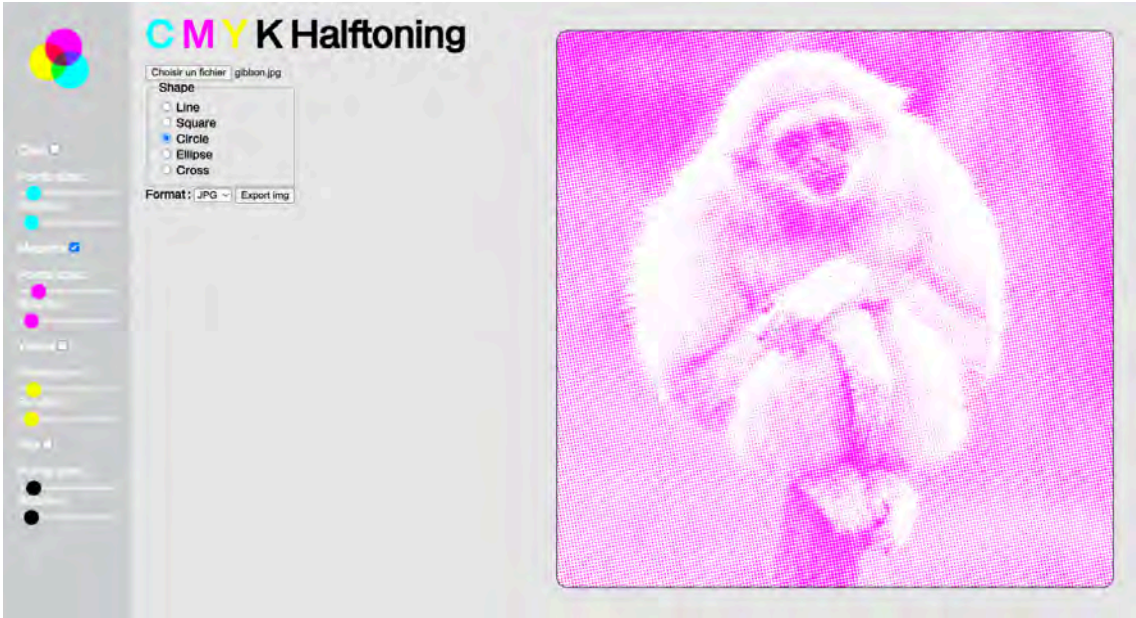
Screening Preview Software

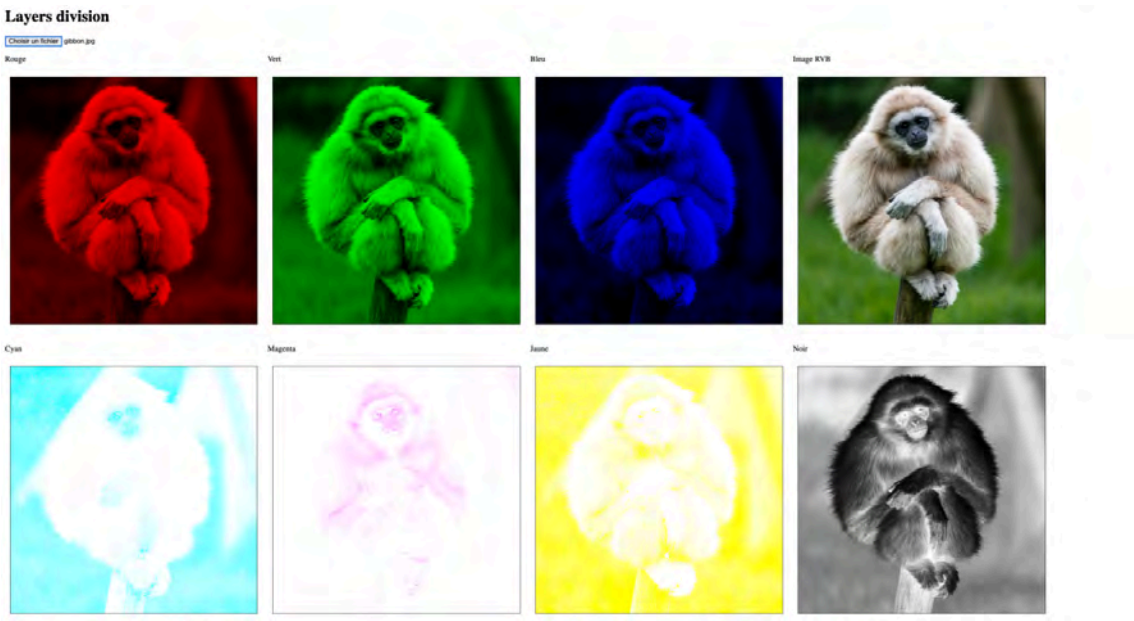
Oguz Ulgen Tunc (Izmir Economic VCD), Filip Marjanović (FGA), Andrea Kevorkian (ESAD·V), Mathis Curcio (ESAD·V), Rayane Baz (Pagora), Nicolas Diemert (Pagora)

Graphic designers frequently face challenges in preparing their images for print, particularly in managing colour layers and halftones. The preview and adjustment solutions currently available are complex to handle, do not fully meet the needs of designers when they want to superimpose coloured screens, and are too expensive.

The practice of silkscreen printing has raised questions about the tools used to preview the layers of coloured screens used to print an image. Although rasterisation is a technical necessity for most printing systems, several algorithms can be used to convert colour tints into a series of coloured dots using either the 4 usual primary colours (CMYK) or spot colours, which can be superimposed to reproduce a wide range of colours. But the screening is also a graphic work in itself, conferring a certain quality on the images, a certain texture that is as much aesthetic as technical.

Despite the importance of the principles of colour separation and layer-by-layer screening, current tools do not allow sufficiently flexible visualisation to 'play' with these principles artistically and graphically. This is a limitation both in the actual practice of silkscreen printing (how can we judge a specific screen in relation to the mesh of a frame and anticipate its result?) and in the training and technical education of students producing their images in silkscreen printing. More broadly, being able to check the result before printing would not only allow for more precise and free visual work, but would also avoid a large number of trials, which can be as much a waste of time as of resources and raw materials.





It was on the basis of these observations that the need arose to design a software package specialised in the parameterisation and visualisation of raster layers, layer by layer, prior to printing. An initial prototype was produced by this group of students during the workshop. It takes the following elements into account:

- import of any picture by the user;
- automatic colour separation in 4 layers (CMYK)
- choice of raster point size

- choice of raster grid rotation
- whether or not to display the colour layer
- choice of dot shape (line, square, circle, ellipse, cross) (not implemented).

Based on this preliminary experience, the EPE team will be able to rely on the support of the NLNet foundation to fund the development of a more sophisticated application, still based on Web technologies. Its specifications will be defined during 2025, with an alpha version to be released in mid-2026.

Figma UI Prototype

LINK TO THE PROTOTYPE:

Sources : https://gitlab.com/esad-gv1/epe/projects/cmyk_halfoningpreviewer-pagora

Live Demo : https://cmyk-halfoningpreviewer-pagora-790aa2.gitlab.io

ECRANPAPIEREDITER *Workshop Prototyping #1* 9 to 13 december 2024 Pagora

	AM		Lunch	PM	
Monday 9	9:00 — 10:00	Classroom D8 Welcome School presentation (Coffee + pastries) Julien Bras, Nadège Reverdy, Lionel Chagas	12:00—1:30 Catering at Pagora Classroom D8	1:30 — 5:00	Classroom D8 Pagora students 1h30—2h30 Color management and Screen management presentations by the students of Pagora
	10:00 — 12:00	Classroom D8 ÉSAD students, Zagreb, Izmir, Dominique Cunin Workshop background, European project Organisation of the week: 4 groups of 5 students			
Tuesday 10	**AM**		**Lunch**	**PM**	
	9:00 — 12:00	Classroom C113, C101, C102, C103, C112 Bibliographic work on Color management, PDF files and screening 4 groups of 5 students How to consider this compatibility in a W2P environment? *A workshop group would work on this issue:* • Sharing basic knowledge on color profiles and printing systems. • Particular focus on spot colors in the context of screen printing and risography. • Digital printing, HP press or similar. *A workshop group would work on this issue:* • Sharing basic knowledge on software screening methods and their inclusion in printing systems (bypass, replacement) • Setting up a screen editor with web technologies (canvas) and specifying a generic module usable in EPE. • Digital and manual or semi-manual printing tests.		1:30 — 5:00	Classrooms C113, C101, C102, C103, C112 Presentation by the students of Bibliographic work on Color management, PDF files and screening and practical work Traditional Color management Calibrate and characterize the Xerox printer Test different screen types on the inkjet printer
Wednesday 11	**AM**		**Lunch**	**PM**	
	9:00 — 12:00	Classrooms C113, C101, C102, C103, C112 Practical work WebToPrint Working with RGB → CMYK color flow RGB → spot color workflow		2:30 — 9:00	2:30—5:30 Guided Tour of Grenoble Want to know more about Grenoble city center, it's history, legends and unexpected unique places such as an exceptional solar clock revealing the science of Jesuit priests of the 17th Century? Follow your English-speaking guide! 7:45 Diner at Bouillon A 5 Place Nelson Mandela, 38000 Grenoble
Thursday 12	**AM**		**Lunch**	**PM**	
	9:00 — 12:00	Classrooms C113, C101, C102, C103, C112 WebToPrint Working with RGB → CMYK color flow RGB → spot color workflow	12:00—1:30 Catering at Pagora Classroom D8	1:30 — 5:00	Classrooms C113, C101, C102, C103, C112 WebToPrint Working with RGB → CMYK color flow RGB → spot color workflow
Friday 13	**AM**		**Lunch**	**PM**	
	9:00 — 12:00	Classrooms C113, C101, C102, C103, C112 WebToPrint Working with RGB → CMYK color flow RGB → spot color workflow	12:00—1:30 Catering at Pagora Classroom D8	1:30 — 5:00	Classroom D8 Presentation of the issues and results of the workshop.

Organization

Problem

A simple project to understand the steps involved in transforming layout files in the printing chain

How to consider this compatibility in a W2P environment ?

- Basic knowledge of color management (calibration, characterization, ICC creation, color workflow)
- Spot color processing
- Basic knowledge of screening
- Create print documents and apply color management and screening
- **Setting up a screen editor with web technologies** and specifying a generic module usable in EPE ?

STEPS

STEP 1

Basic knowledge on color management and screening

- Presentation by pagora students and bibliographic works
- Choice and management of destination color space (given by printing technique),
- Pantone-type color palette management: what exactly is direct tone management in the entire chain(s)?
- How to integrate a colorimetric profile after exporting a PDF ?
- What is a PDF file for printing and how is its color management designed ?

STEP 2

Practical works on color management

- Calibration, Characterization, ICC profile creation

STEP 3

Graphic creation

- Documents with spot colors and CMYK colors. Large poster for screen and inkjet printing. Works with Adobe Software and free software ?

STEP 4

Practical works: Print

- Printing of documents with spot colors and CMYK colors. Large poster for screen and inkjet printing. Works with Adobe Software and free software ?

Planning

Week of December 9 to 13, 2024

	AM		Lunch	PM	
Monday 9	9:00 - 10:00	**Classroom D8 - Welcome** School presentation (Coffee + pastries) - **Julien Bras, Nadège Reverdy, Lionel Chagas…**	12:00 - 1:30 Traiteur à Pagora Salle D8	1:30 - 5:00	**Classroom D8** 1:30 - 2:30 : Pagora students - Color management and Screen management presentations by the students of Pagora 2:30 - 3:00: Break 3:00 - 5:00 : Bibliographic work on color management, PDF Files and Screening
	10:00 - 12:00	**Classroom D8 - ESAD students, Zaghreb,….Dominique Cunin** Workshop background, European project Organisation of the week : 4 groups of 5 students ? Which visuals to print? Serigraphy or inkjet?			
	AM			**PM**	
Tuesday 10	9:00 - 12:00	**Classrooms C113, C101, C102, C103, C112** **Bibliographic work on Color management, PDF files and screening 4 groups of 5 students** How to consider this compatibility in a W2P environment? A workshop group would work on this issue: • Sharing basic knowledge on color profiles and printing systems. • Particular focus on spot colors in the context of screen printing and risography. • Digital printing, HP press or similar. A workshop group would work on this issue: • Sharing basic knowledge on software screening methods and their inclusion in printing systems (bypass, replacement) • Setting up a screen editor with web technologies (canvas) and specifying a generic module usable in EPE. • Digital and manual or semi-manual printing tests.		1:30 - 5:00	**Classrooms C113, C101, C102, C103, C112** **Presentation by the students of Bibliographic work on Color management, PDF files and screening and practical work** Traditional Color management Calibrate and characterize the Xerox printer Test different screen types on the inkjet printer

Planning

	AM			PM	
Wednesday 11	9:00 - 12:00	**Classrooms C113, C101, C102, C103, C112** **Practical work** **WebToPrint** Working with RGB > CMYK color flow RGB > spot color workflow		1:30 - 9:00	**2:30 – 5:30 : Guided Tour of Grenoble** Want to know more about Grenoble city center, it's history, legends and unexpected unique places such as an exceptional solar clock revealing the science of Jesuit priests of the 17th Century? Follow your English-speaking guide! Meeting point : Tourist office, 14 rue de la République, Grenoble **7:45 - Diner at Bouillon A** 5 Place Nelson Mandela, 38000 Grenoble
Thursday 12	9:00 - 12:00	**Classrooms C113, C101, C102, C103, C112** **WebToPrint** Working with RGB > CMYK color flow RGB > spot color workflow	12:00 - 1:30 Traiteur à Pagora Salle D2	1:30 - 5:00	**Classrooms C113, C101, C102, C103, C112** **WebToPrint** Working with RGB > CMYK color flow RGB > spot color workflow
Friday 13	9:00 - 12:00	**Classrooms C113, C101, C102, C103, C112** **WebToPrint** Working with RGB > CMYK color flow RGB > spot color workflow	12:00 - 1:30 Traiteur à Pagora Salle D8	1:30 - 5:00	**Classroom D8** **Presentation of the issues and results from the workshop.**

5

Organization

4 groups of 5

- 1 student from Zaghreb, 1 student from Izmir, 1 student from Valence, 2 students from Pagora

Rooms

- C102, C103, C101, C113
- Monday room D8
- Friday PM Room D8

Equipments and sofwares

- EPSON inkjet printer, RIP Wasatch
- XEROX Versant 180 printer, RIP FreeFlow
- Screen printing press
- FD-7, FD-9, Exact 2… spectrophotometers,
- FD S2w, BasicColor, eye 1 profiler, Excel
- …

Color management: calibration, characterization, ICC profile creation

Goals

The aim of color management

To ensure that the colors of an original document are preserved throughout the document processing chain.

- Scanner or digital camera,
- Monitor,
- Printers.

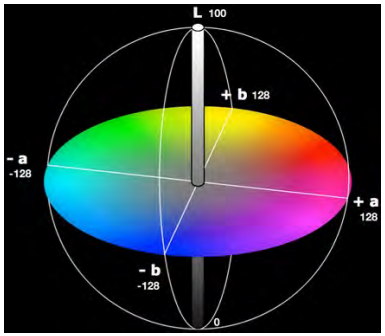
This management is necessary because the color acquisition, viewing and reproduction modes are all different.

- A. scanner needs color filters Rs, Vs, Bs to “see” color. A screen displays colors because it has Re, Ve, Be luminophores. A laser printer enables color printing thanks to the primary inks Ci, Mi, Ji, Ni.
- Color is represented by non-identical primaries.
- Red 126 on the scanner does not give the same color as red 126 on the screen

Color management

Color management flow chart

Make all materials understand each other by using an independent color space that describes color in absolute terms.



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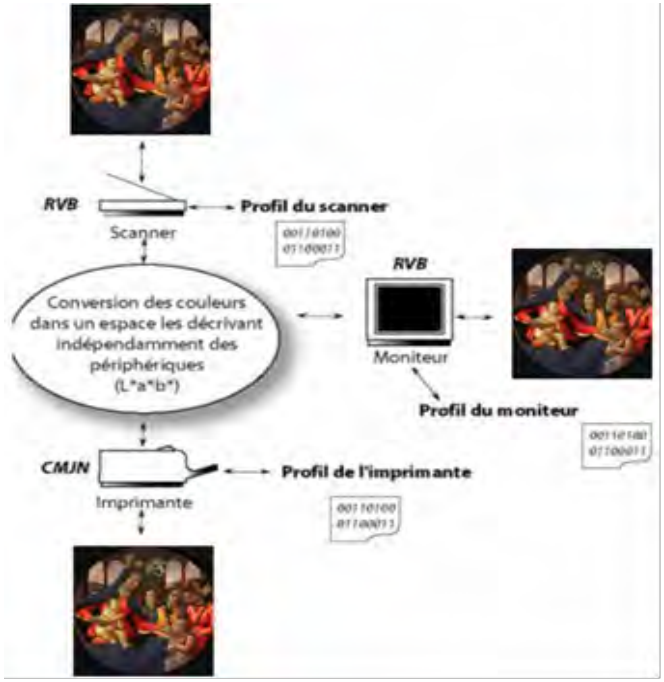
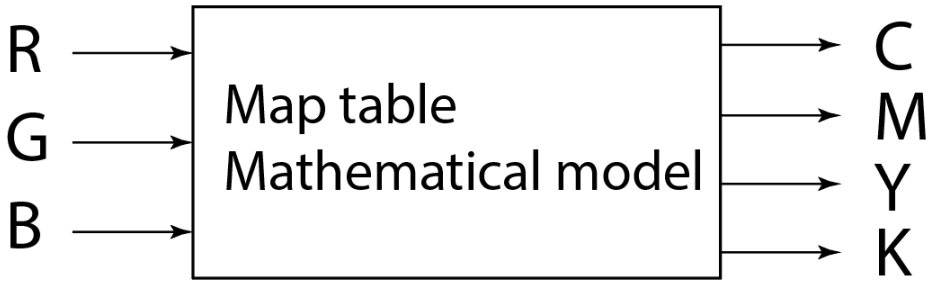


OK NOK

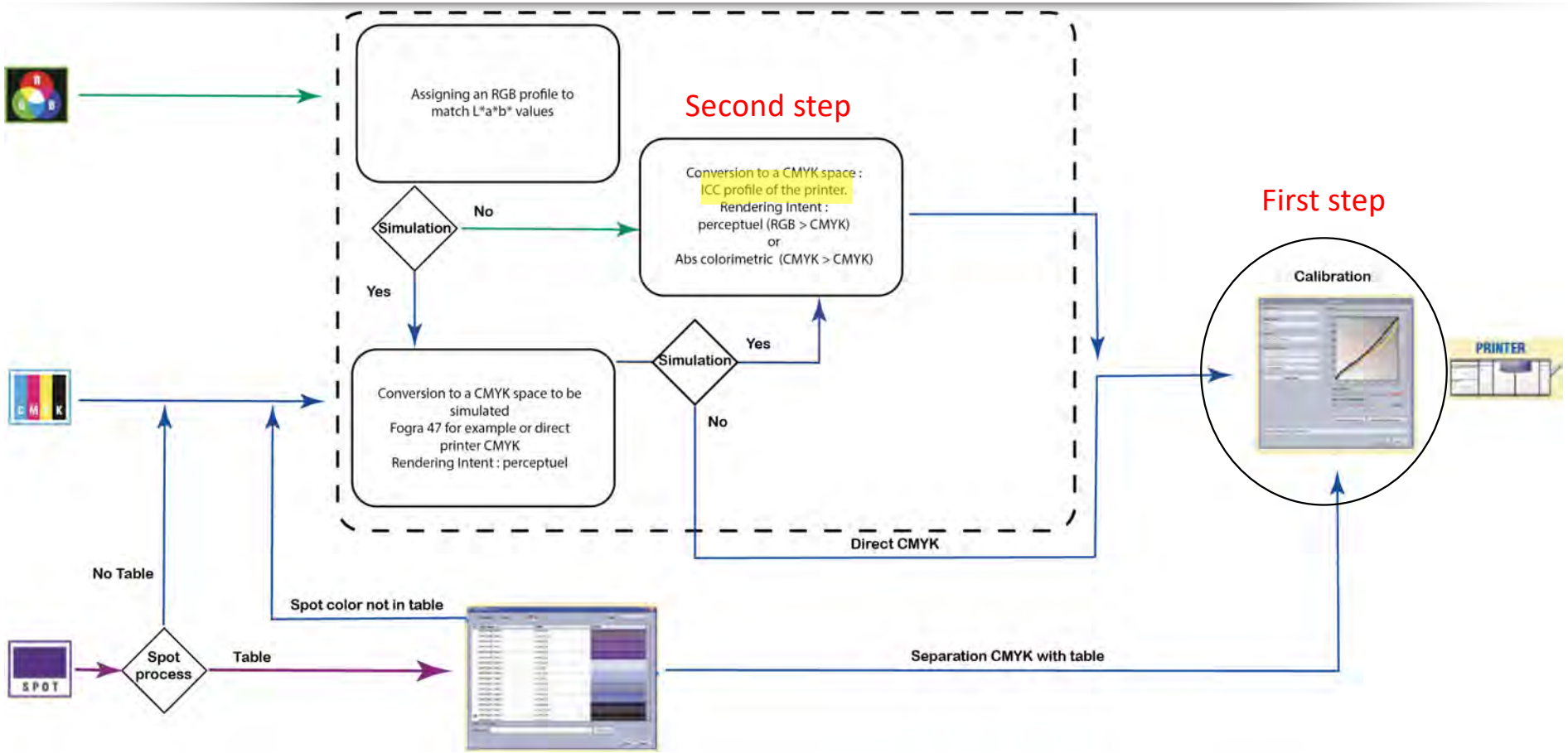
Color management

Converting from one color mode to another

- mapping tables
- modeling



Color workflow



Printers settings

Color management involves

- Calibration of device (printer),
- Characterization of materials,
- ICC (or other) profile creation.

Printers settings

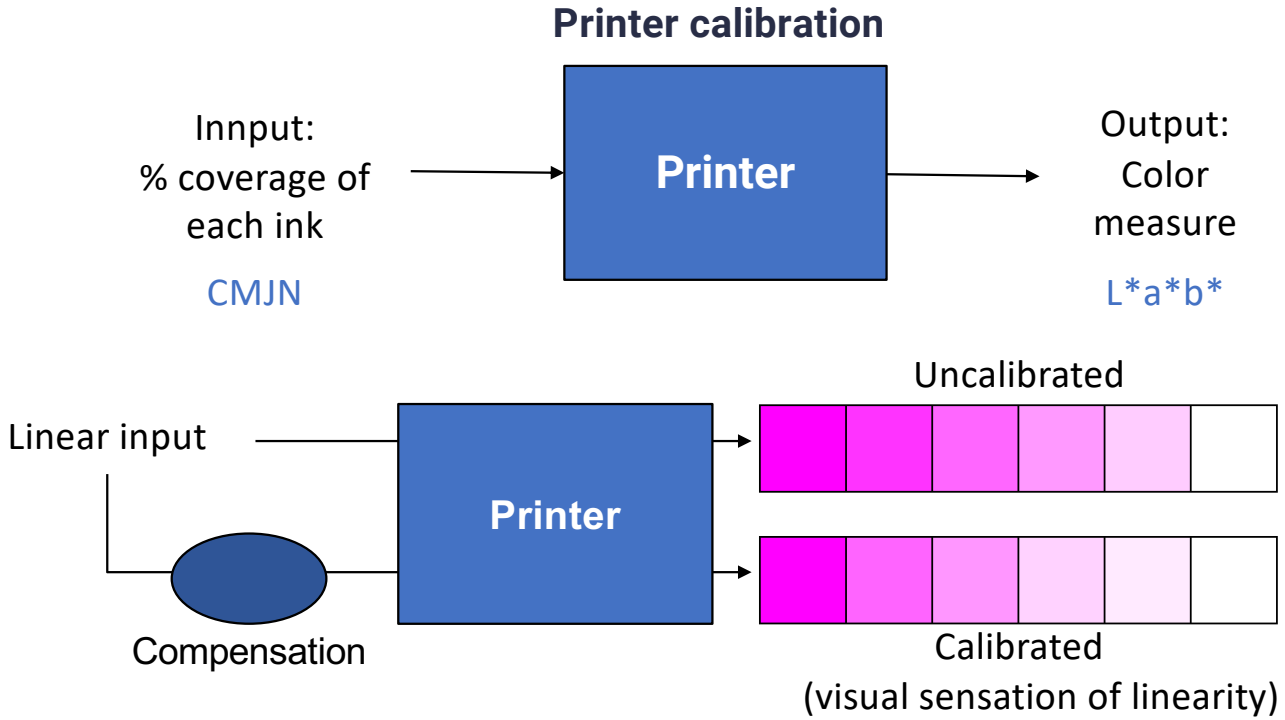
Equipment

FD-9 spectrophotometer, Xerox Versant 180 printer, test forms.

Software

Photoshop, (Acrobat DC), FD S2w, BasicColor, eye 1 profiler, Excel.

Step 1



Objective: to ensure that the printer has a linear colorimetric response by applying compensation to the input coverage percentages.

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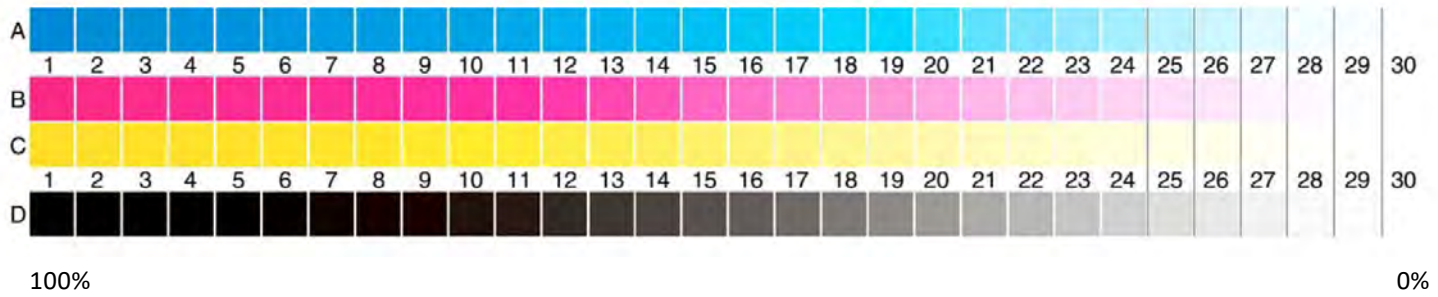
Step 1

1. **Calibrate and check printer calibration**
   - ✓ Print a test shape, characterize its color
   - ✓ Draw ΔE = f (%digital coverage),
   - ✓ Determine compensation curves,
   - ✓ Check that the compensation curves allis ok.
2. **Characterize printers and create an ICC profile.**

If necessary

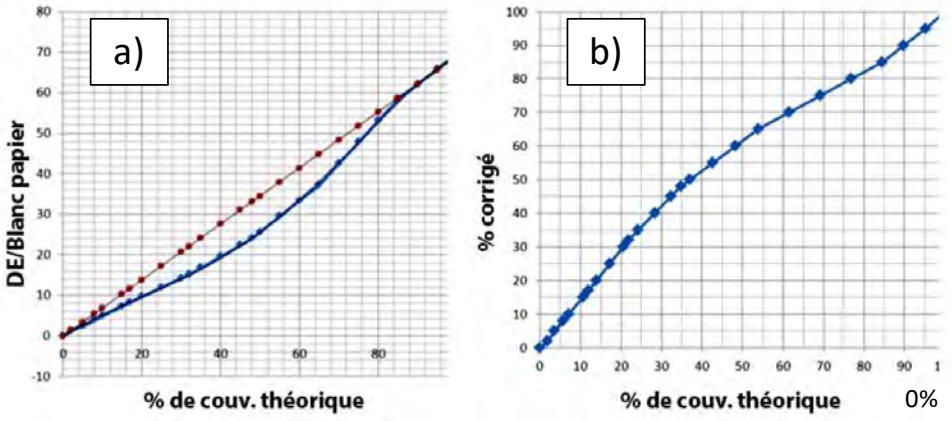
2. **Simulate an over kind of printing.**
3. **Check that the simulation is correct**

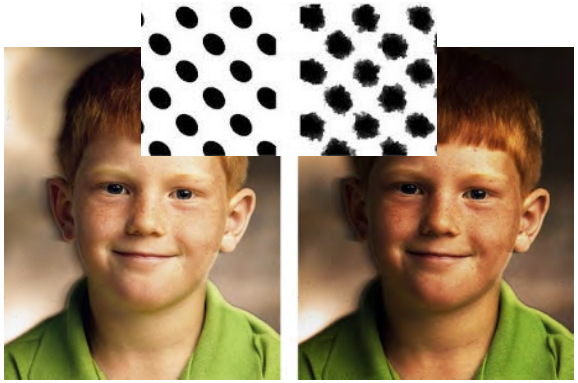
Basic calibration in practice



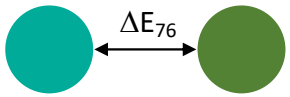
1. Print this test form with color management disabled
2. Measure the color of each patch using a spectrophotometer (L*a*b*)
3. Plot the curves $\Delta E = f(\%\ coverage)$
4. Create compensation curve

Plot the curves ΔE = f(% coverage) and create the componsation curve for each color



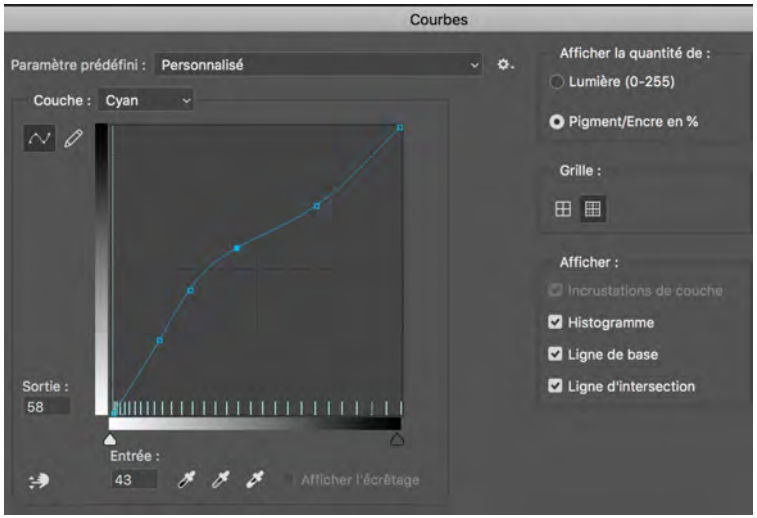


1. Plot the curve ΔE76 = f(a%), with a% the theoretical percentage coverage
2. Determine curve b).

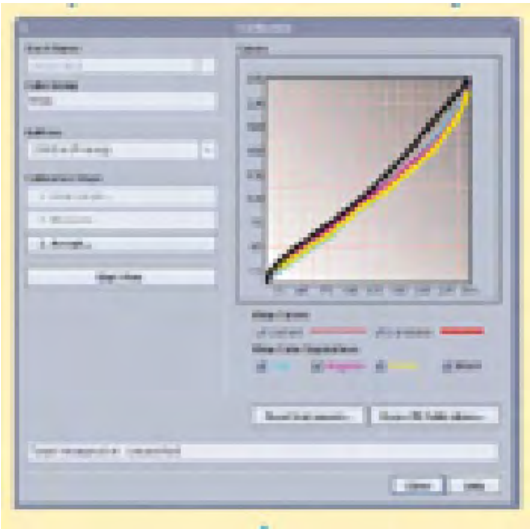


ΔE_{76} : distance, between two colors

Create the compensation curve in Photoshop or in the RIP

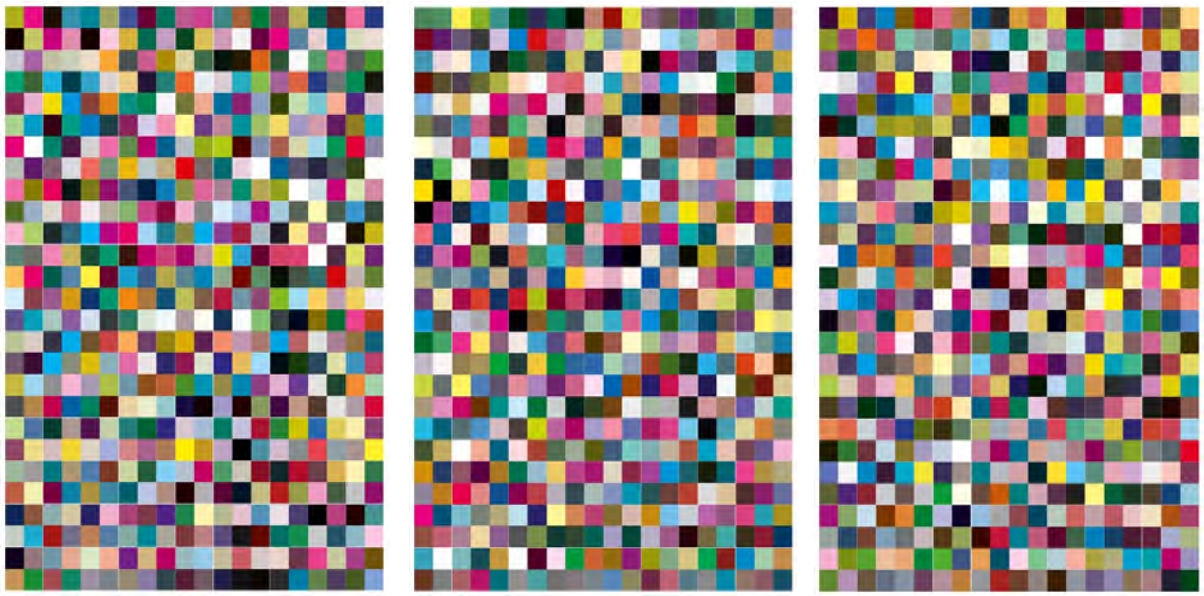


Photoshop

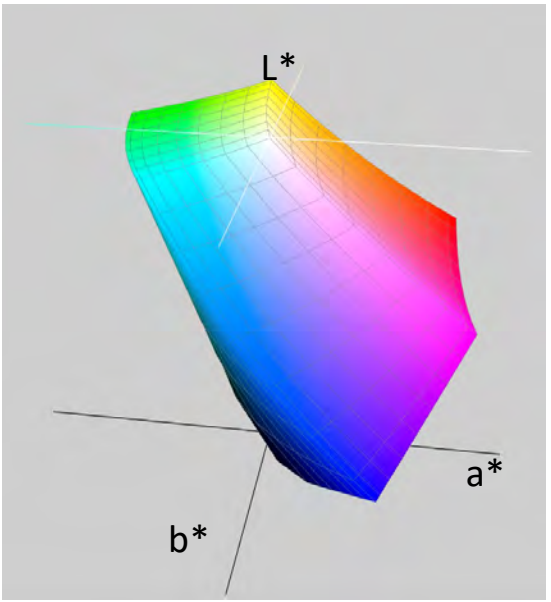


RIP FreeFlow

Characterization of printer and creation of an ICC profile

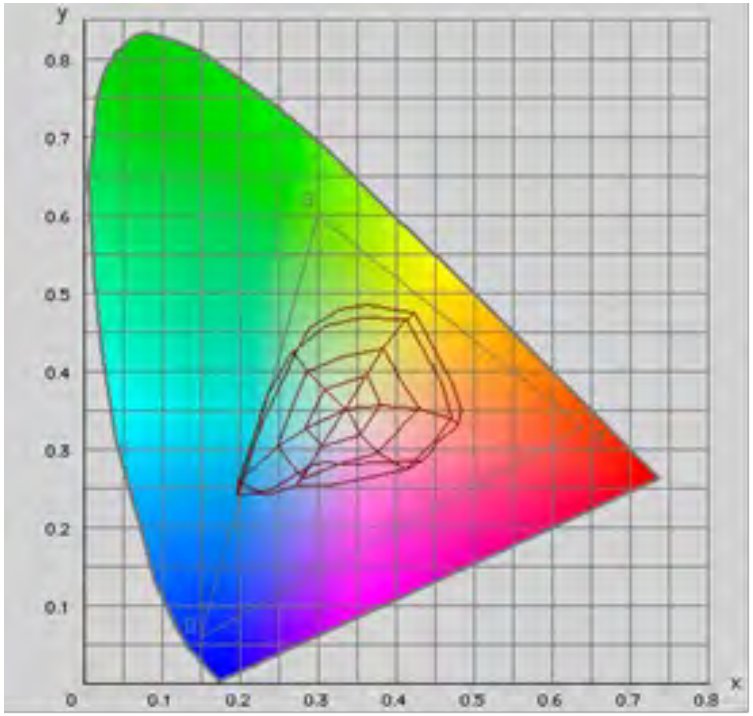


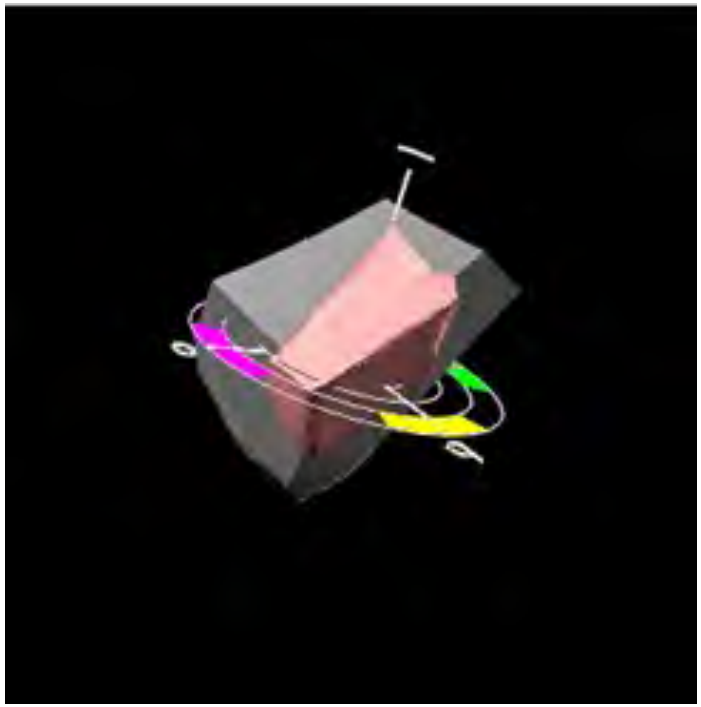
Print 1620 test patches with color management disabled.
Measure the color of each patch using a spectrophotometer (L*a*b*)
Link L*a*b* > CMYK



Printer gamut.

Comparaison de 2 gamuts (PSO uncoated – sRVB)





Link CMYK > L*a*b*

Cf52	Mf52	Jf52	Nf52	Lric*	aric*	bric*
85	30	40	0	46,6	-25,19	-26,78
85	30	55	0	49,02	-28,79	-13,78
85	30	70	0	45,63	-36,15	6,18
85	30	85	0	44,83	-40,81	15
85	40	0	0	46,43	-6,95	-49,26
85	40	10	0	45,97	-10,79	-45,76
85	40	100	0	43,81	-33,4	23,5
85	40	20	0	46,84	-13,77	-39,48
85	40	30	0	48,04	-15,72	-32,59
85	40	40	0	45,36	-19,94	-27,06
85	40	55	0	43,96	-24,41	-13,28
85	40	70	0	44,34	-29,39	1,74
85	40	85	0	41,52	-33,94	13,12
85	55	0	0	39,4	2,74	-47,35
85	55	10	0	40,98	-2,02	-44,19
85	55	100	0	35,97	-21,87	17,81
85	55	20	0	40,32	-3,8	-40,34
85	55	30	0	39,88	-2,8	-33,4
85	55	40	0	38,95	-6,41	-26,13
85	55	55	0	39,57	-9,07	-16,94

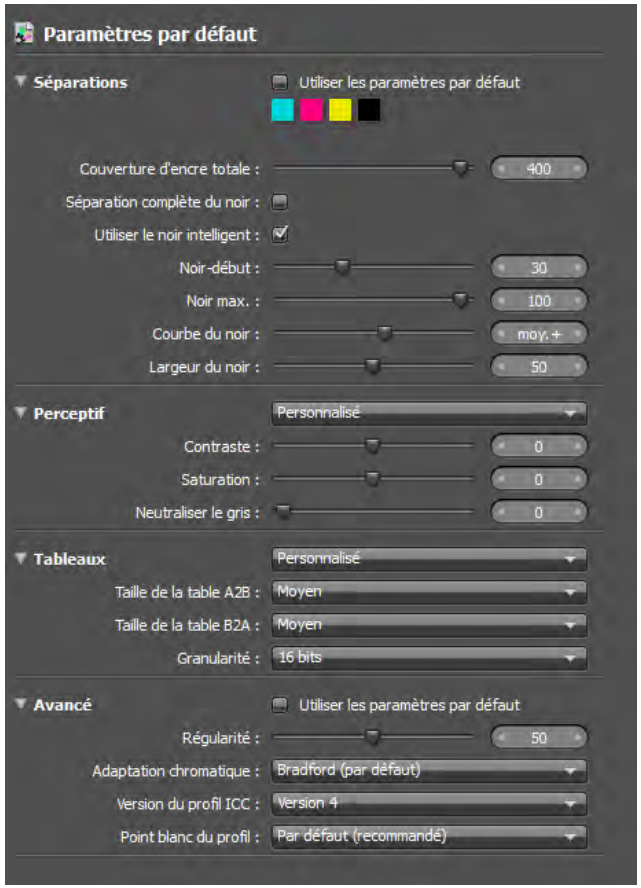
ICC profil creation - BasicColor Software

1 characterization file = several ICC profiles

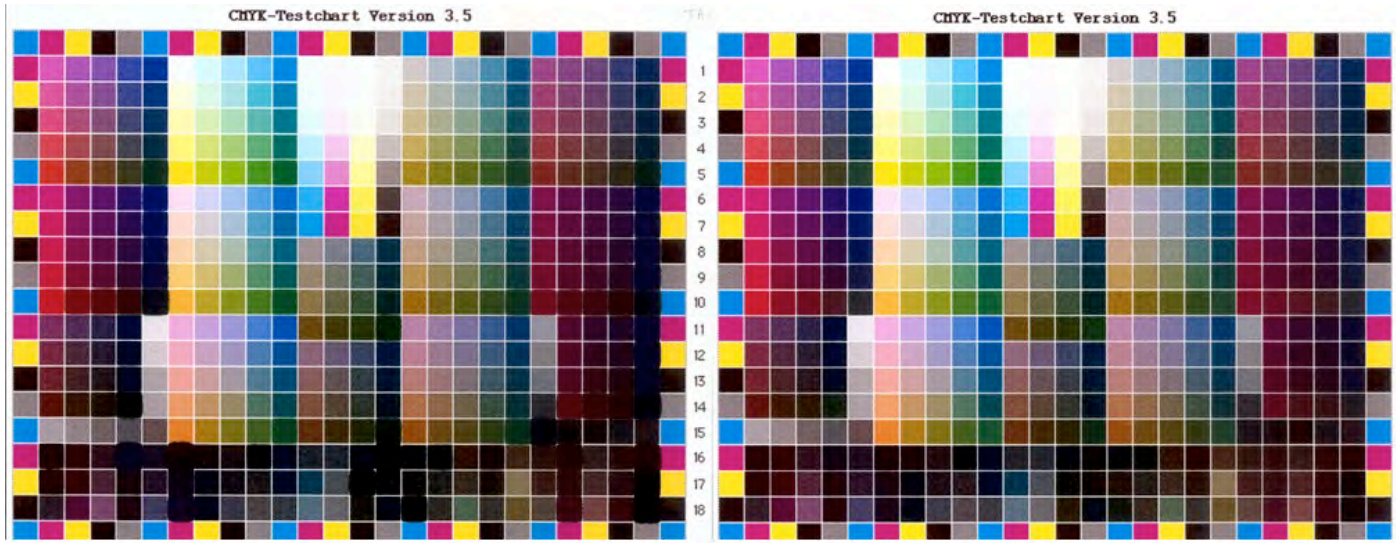
Total area coverage

Under Color Removal or Gray Component Replacement

Eye1 Profiler



Total area coverage



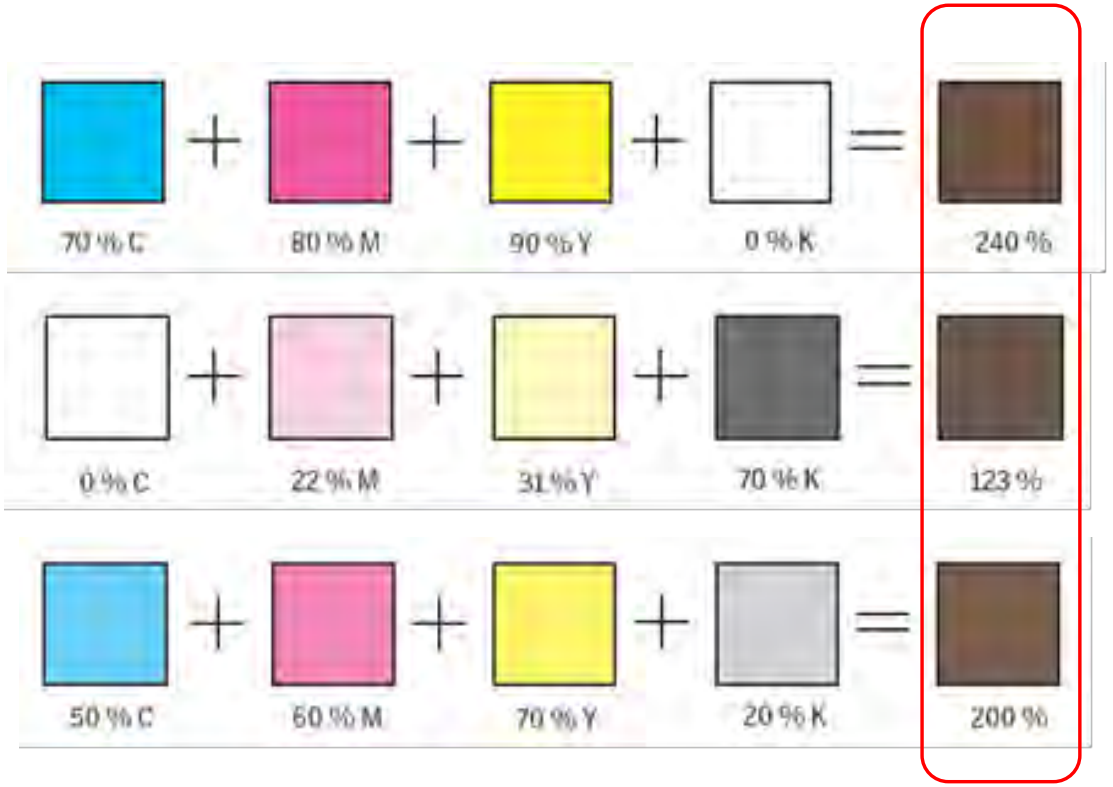
TAC 280%

TAC 160%

Bad settings

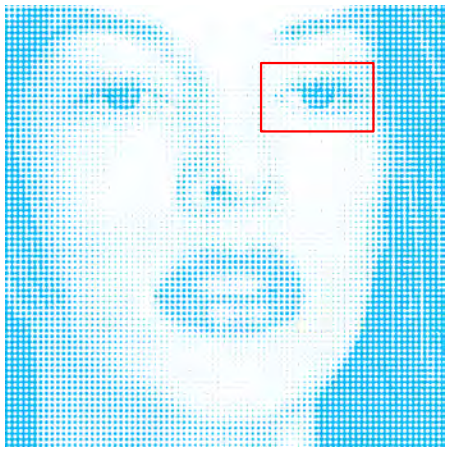
Good settings

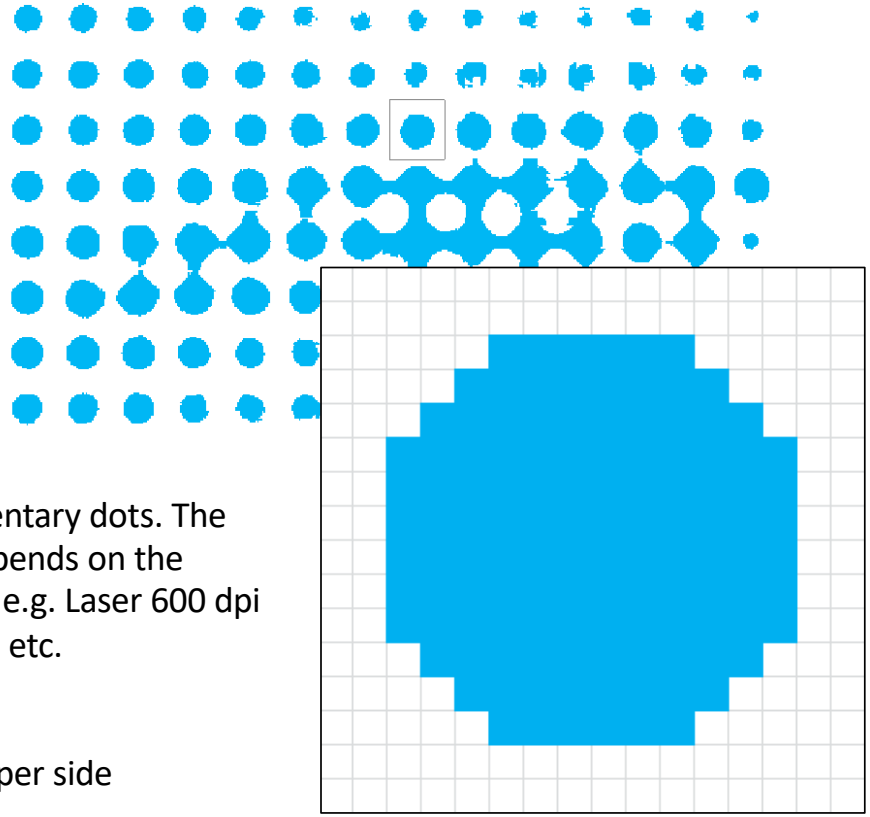
Gray Componant Replacement, Under Color Removal
GCR, UCR



Screening

Screening

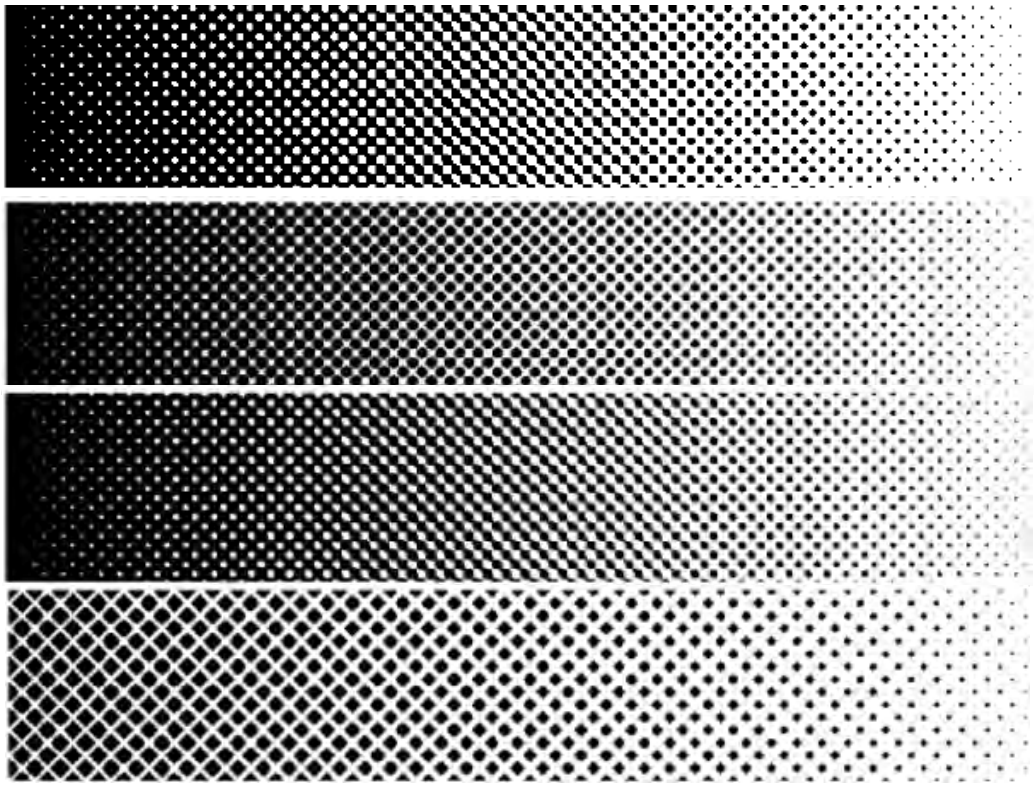




A screen dot is made up of elementary dots. The size of these elementary dots depends on the resolution of the printing device: e.g. Laser 600 dpi (~40 µm), CTP 2400 dpi (~10 µm) etc.

Matrix size
E.g.: 2400 dpi/150 lpi = 16 pixels per side

Screening



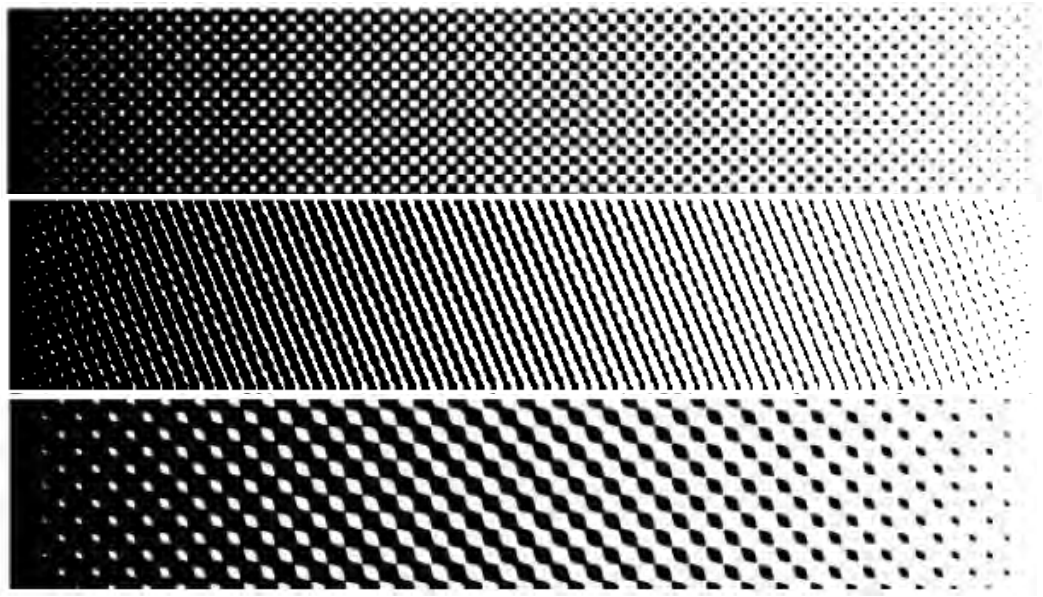
Fogra/Round
Offset – flexography

Circular
Flexo-Typo

Elliptical
Offset - flexography

Gravure printing

Screening



square dots

Often to be avoided:
intensity jump to 50%.

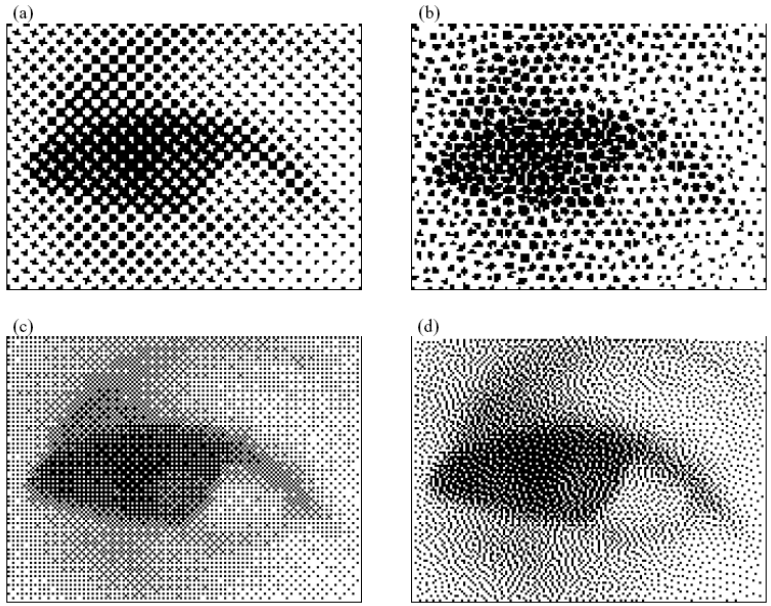
Excentric

Offset-Flexography

Rugby

Screening

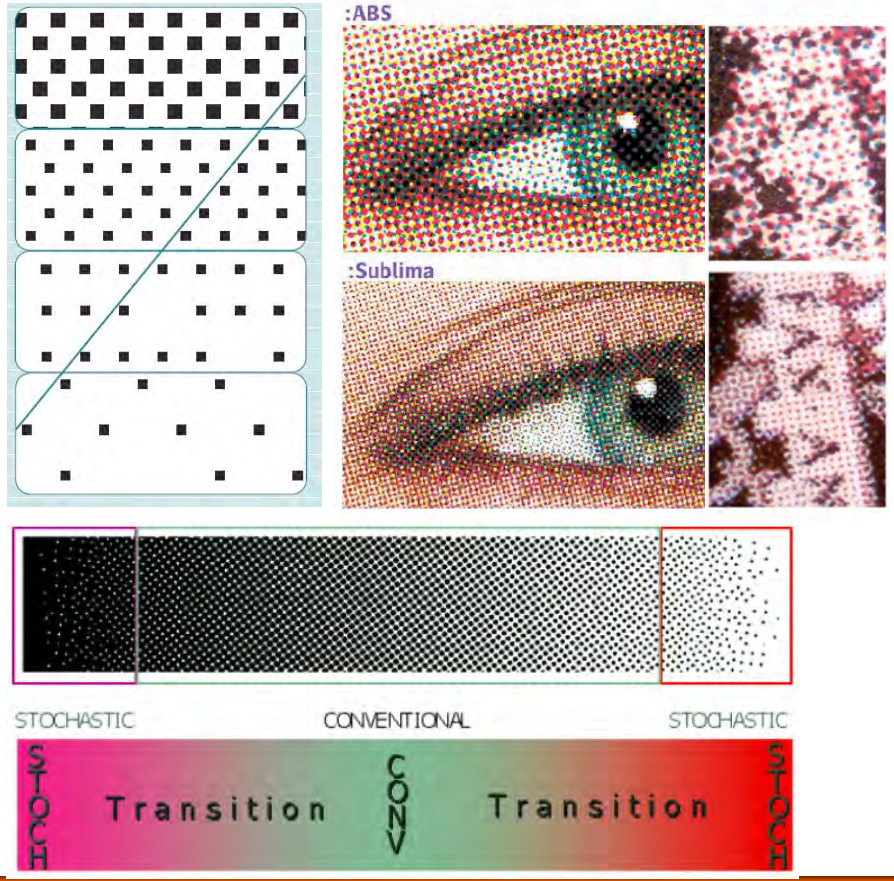
Screening – Main screen families



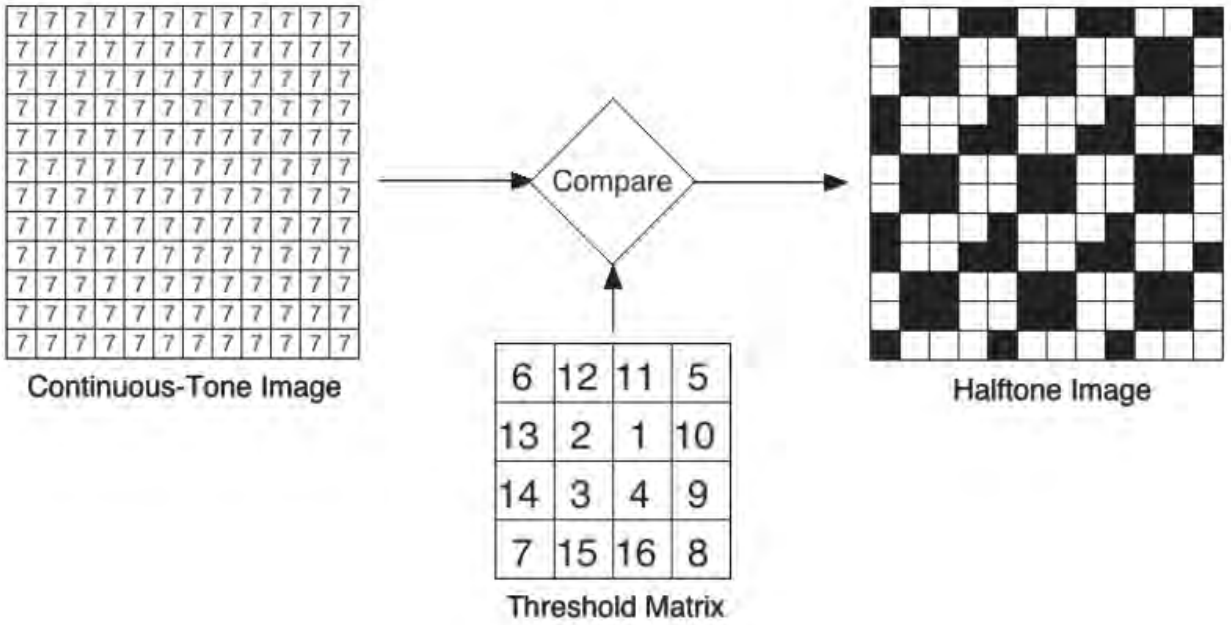
Main screen families

(a) ordered with centered dots: variable point size, constant dot spacing (AM)
(b) random with centered dots,
(c) dispersed ordered
(d) dispersed random: constant dot size (FM)

Screening – Hybrid screening



Screening – Dot formation, Thresholding matrix



Screening – Dot formation, Thresholding matrix

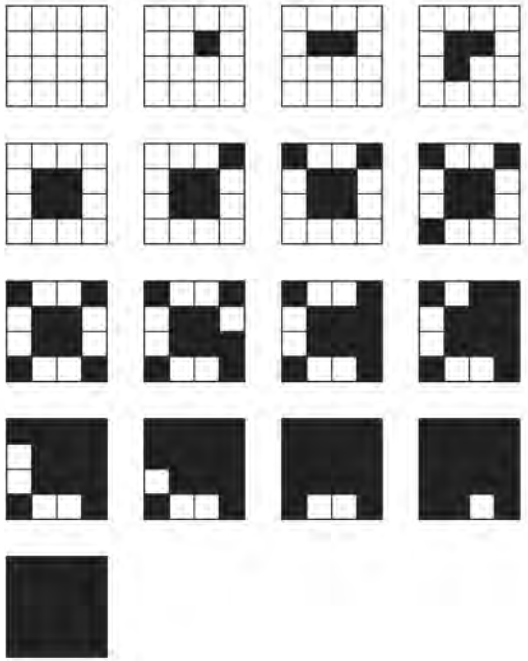
Each pixel is blackened in order of priority. In the example we start by blackening 1, then 2 and so on.

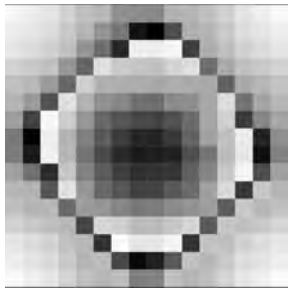
If raster point coverage is 50%, blackening stops at 8.

Threshold Matrix

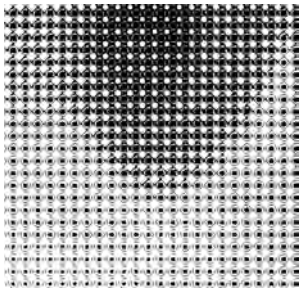
6	12	11	5
13	2	1	10
14	3	4	9
7	15	16	8

Dot Profile

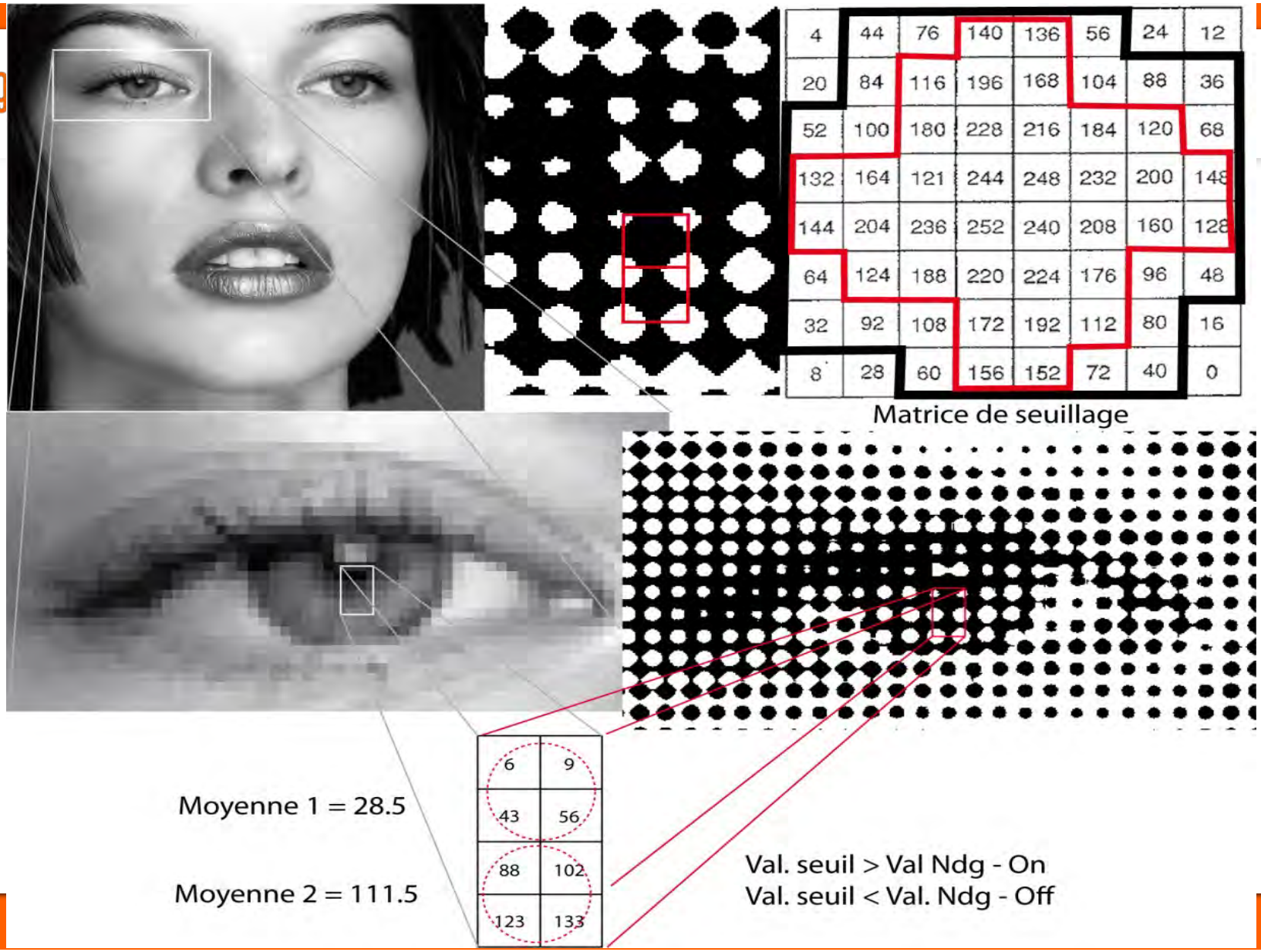




Example of threshold matrix in Photoshop – 16 x 16 pixels



Result on an image


4 44 76 140 136 56 24 12
20 84 116 196 168 104 88 36
52 100 180 228 216 184 120 68
132 164 121 244 248 232 200 148
144 204 236 252 240 208 160 128
64 124 188 220 224 176 96 48
32 92 108 172 192 112 80 16
8 28 60 156 152 72 40 0
Matrice de seuillage
6 9
43 56
88 102
123 133
Moyenne 1 = 28.5
Moyenne 2 = 111.5
Val. seuil > Val Ndg - On
Val. seuil < Val. Ndg - Off

Screening – Dot formation, error diffusion algorithm

Floyd-Steinberg algorithm

	X	7/16
3/16	5/16	1/16

Z X A E F G H…
D C B J K L M…
N P Q R S T…

Z X A' E F G H…
D' C' B' J K L M…
N P Q R S T…

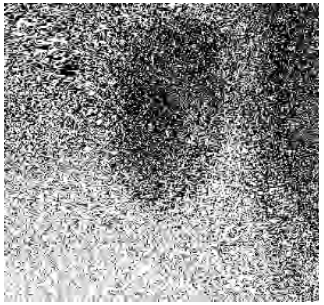
How the Floyd-Steinberg algorithm works

X is compared with a threshold S

If X <= S ==> e= X ifelse e = X - 1
A' = A + 7e/16
B' = B + e/16
C' = C + 5e/16
D' = D + 3e/16

Advance 1 pixel with new values

If A' <= S ==> e = A' ifelse e = A' - 1
E' = E + 7e/16 J' = J + e/16
B'' = B' + 5e/16 C'' = C' + 3e/16…



Result

When a line is finished, we move on to the next line. In this algorithm, the value of a pixel is recalculated 4 times before it reaches its final value, which is then transformed into 0 or 1 depending on the threshold.

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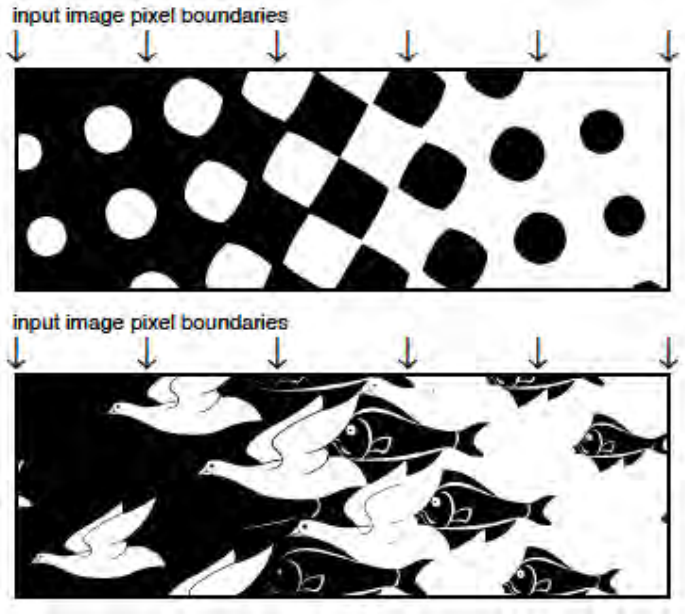
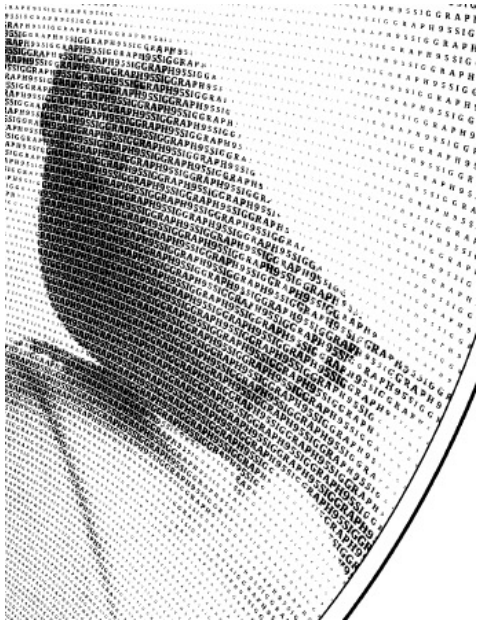
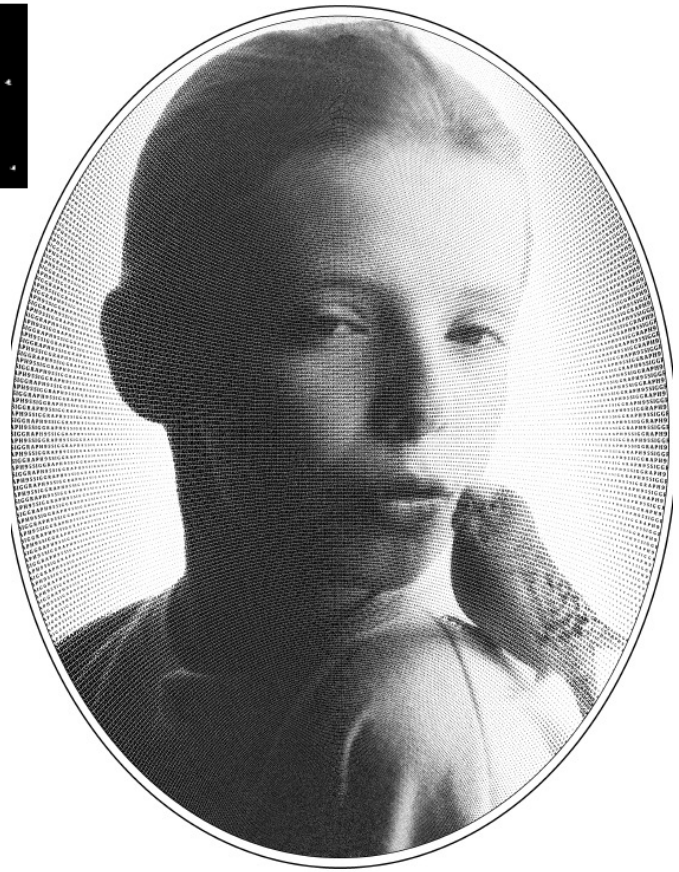
Screening with custom shapes







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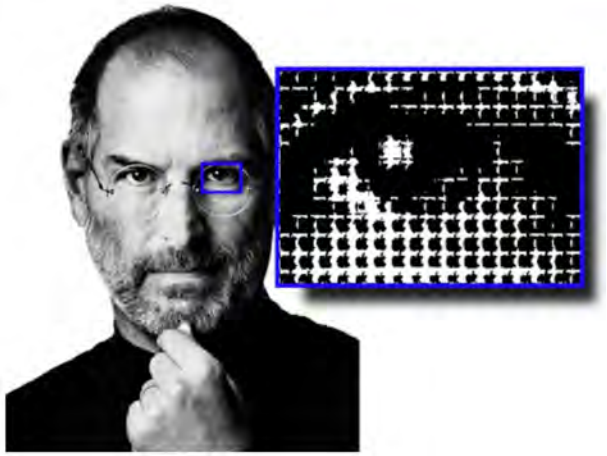
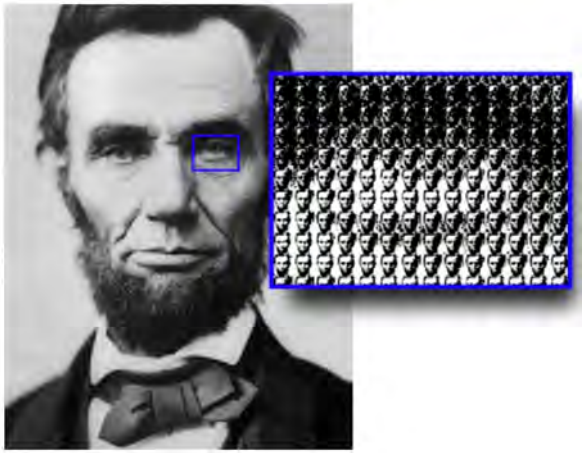
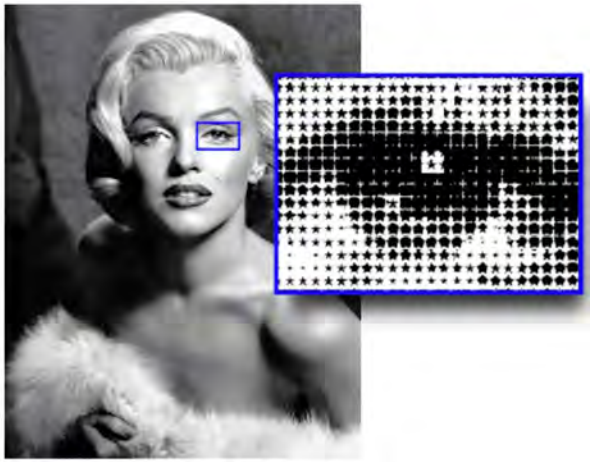
Screening with custom shapes







Annexes

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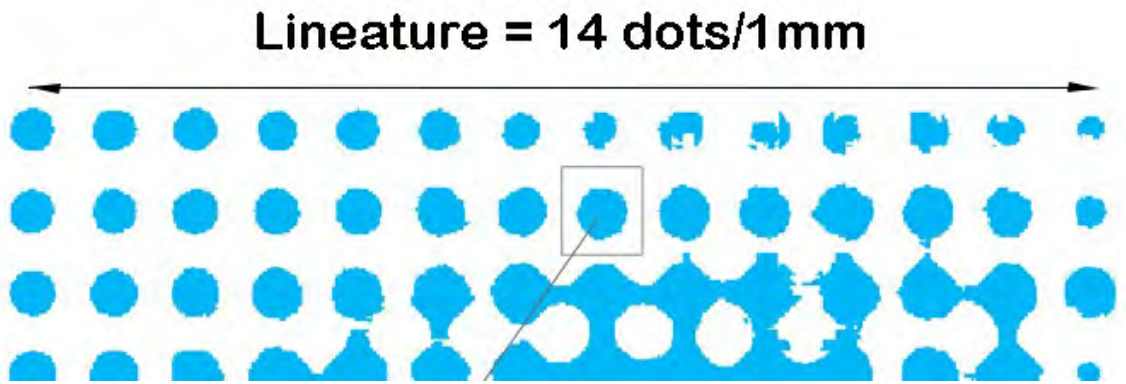
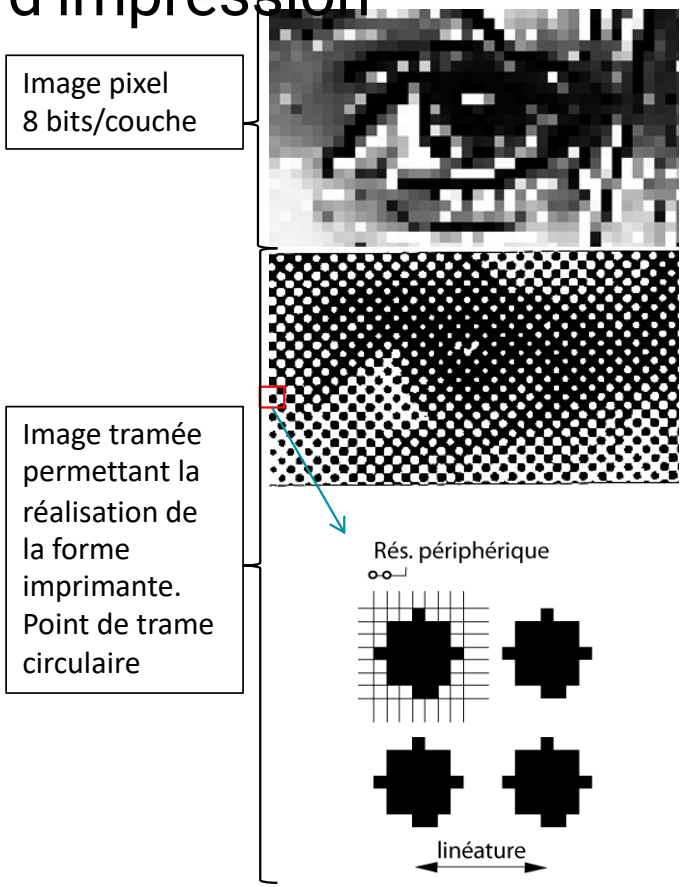
Le tramage
Lien résolution des images, résolution machines, linéature d'impression



Le tramage
Lien résolution des images, résolution machines, linéature d'impression

Résolutions, linéatures, profondeur de couleur

- ✓ Images matricielles numériques
  - résolution (nb de pixels par unité de longueur)
  - profondeur de couleur d'un pixel
- ✓ Périphériques d'affichage ou d'impression :
  - résolution (nb de pixels par unité de longueur)
  - profondeur de couleur
- ✓ Trame
  - linéature



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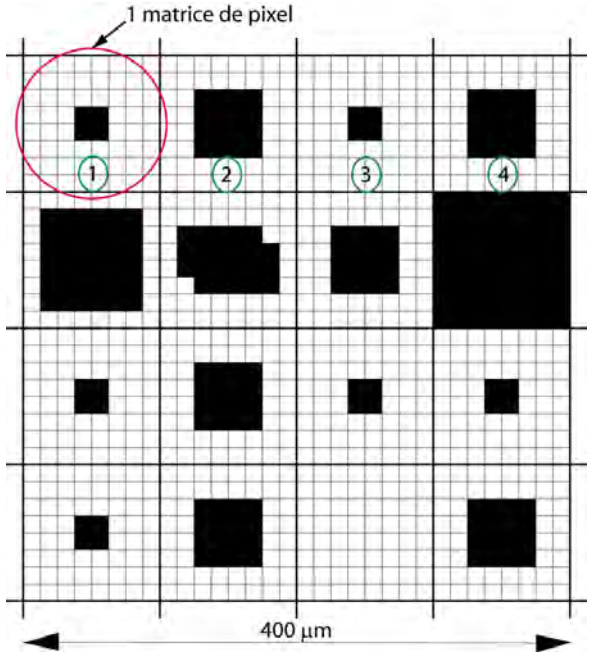
Le tramage
Lien résolution des images, résolution machines, linéature d'impression

Calcul de résolution de périphérique et de linéature d'impression

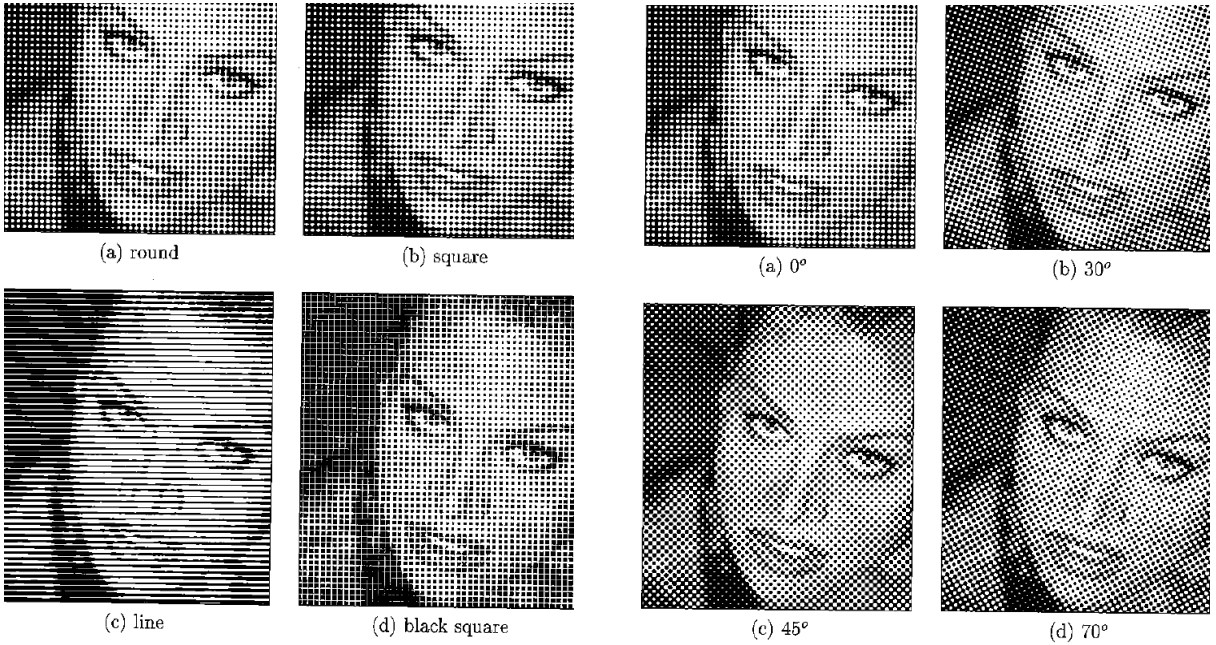
Sur la figure ci-dessous sont représentés des points de trame imprimés selon un angle de 0°. On peut voir également la matrice de pixels utilisée par le CTP (Computer To Plate) pour réaliser les points de trame. La matrice élémentaire du CTP est composée de 8 x 8 pixels.



Représentation de 16 points de trame (4 x 4) qui doivent être imprimés en noir.

Le tramage

- **Forme du point** à relier, notamment, avec son élargissement mécanique
- **Orientation** des lignes en lien avec le phénomène de moirage
- **Linéature** (résolution du système) : les points générés sont alignés
- **Taille du point** qui participera à la nuance de la couleur à reproduire.



Paramètres d'une trame conventionnelle : AM

5. Les profils ICC

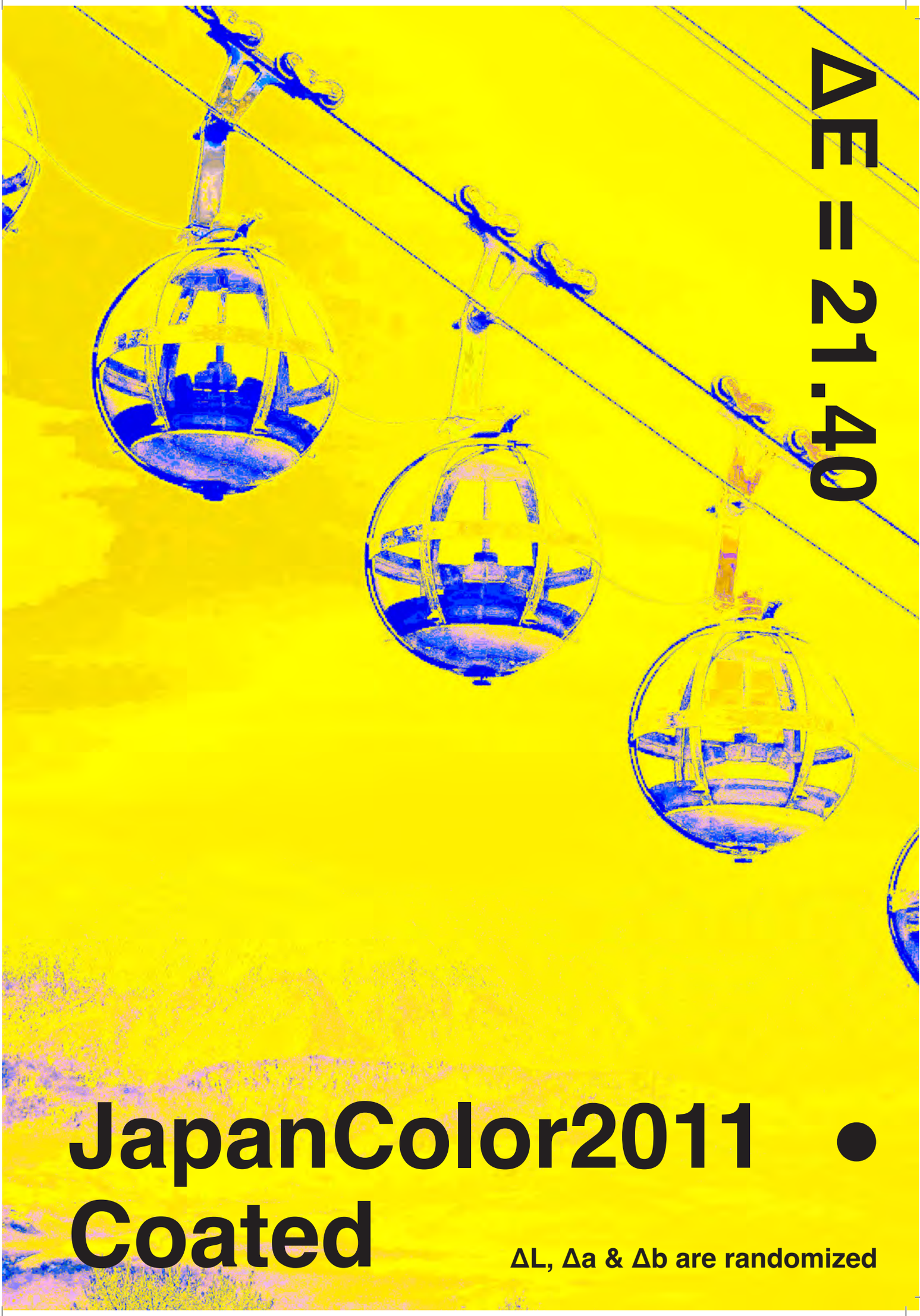
Modèle

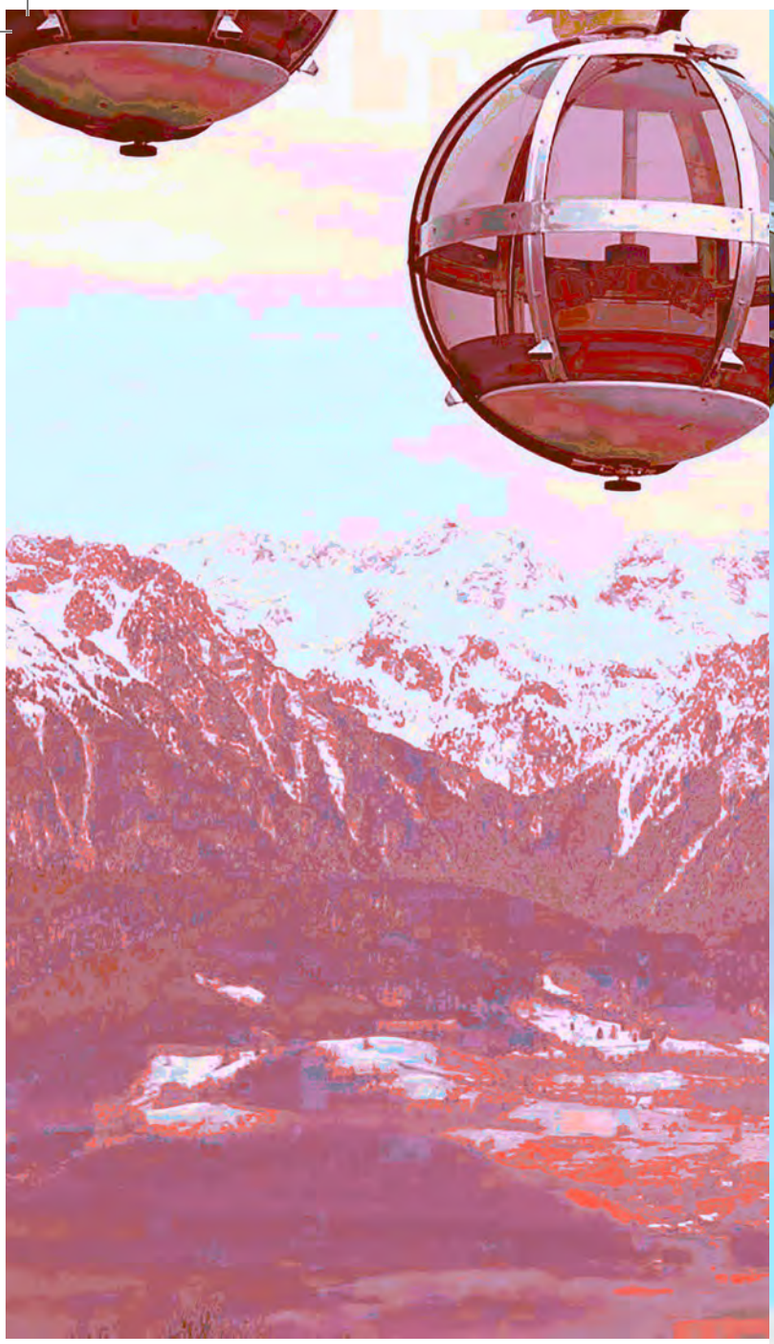
En ce qui concerne les espaces de travail RVB les plus courants (sRVB, Adobe RVB 98 et ISO RVB) la relation entre RVB et XYZ est bien définie.

sRVB

$$\begin{pmatrix} X \\ Y \\ Z \end{pmatrix} = \begin{pmatrix} 0{,}4124 & 0{,}3576 & 0{,}1805 \\ 0{,}2126 & 0{,}7152 & 0{,}0722 \\ 0{,}0193 & 0{,}1192 & 0{,}9505 \end{pmatrix} \begin{pmatrix} R \\ V \\ B \end{pmatrix}$$

$$\begin{pmatrix} R \\ V \\ B \end{pmatrix} = \begin{pmatrix} 3{,}241 & -1{,}5374 & -0{,}4986 \\ -0{,}9692 & 1{,}8760 & 0{,}0416 \\ 0{,}0556 & -0{,}2040 & 1{,}0570 \end{pmatrix} \begin{pmatrix} X \\ Y \\ Z \end{pmatrix}$$


ΔE = 21.40
JapanColor2011
Coated
ΔL, Δa & Δb are randomized



ΔL constant
Δa & Δb randomized
ΔE = 25,60

ΔL & Δa are constant
Δb randomized
ΔE = 25,30

Photo by Nicolas Marlin

ΔL & Δb are constant
Δa randomized
ΔE = 11,9


ΔE = 25.60
ΔL, Δa & Δb are randomized
ΔL constant
Δa & Δb randomized
ΔE = 21

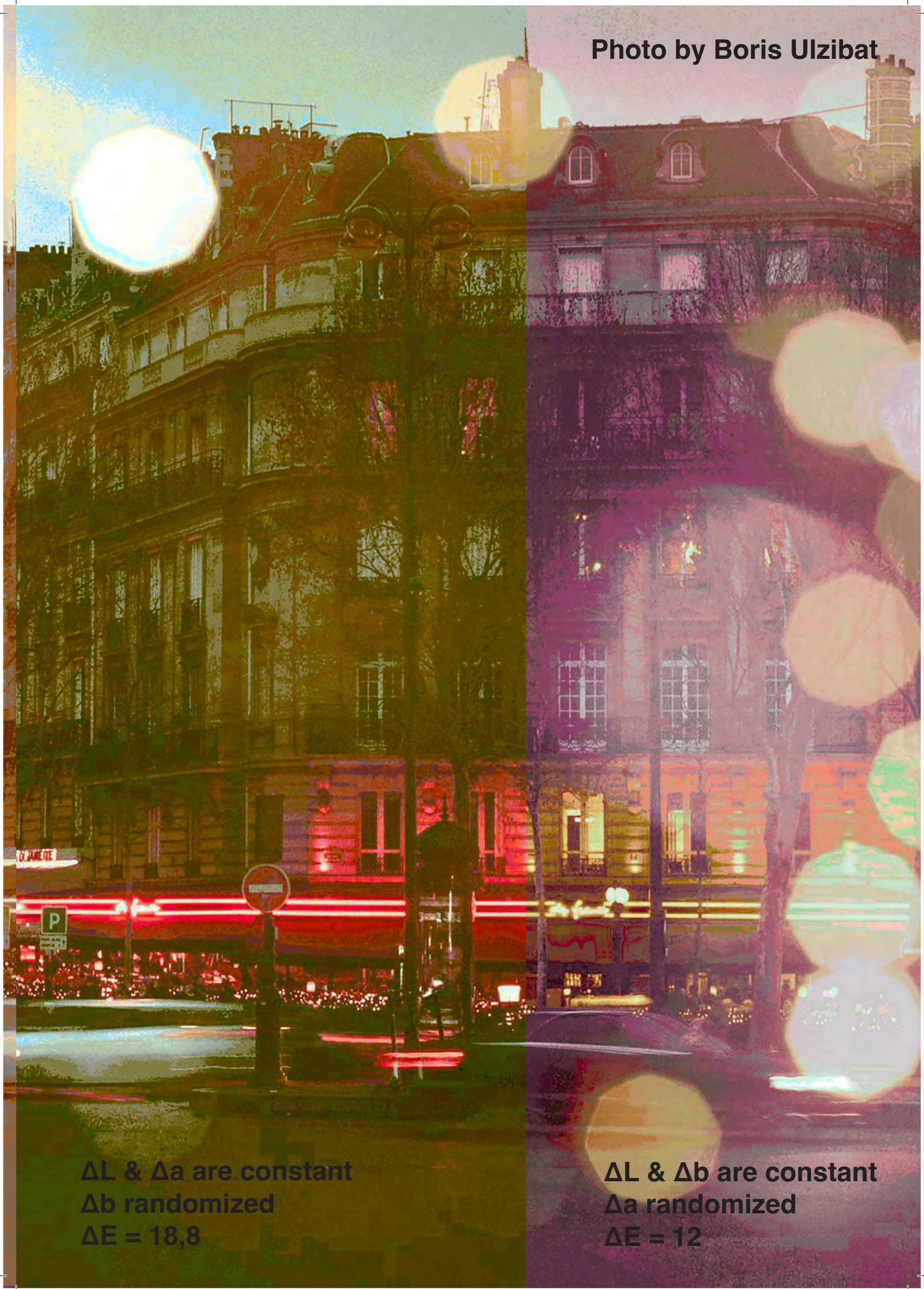
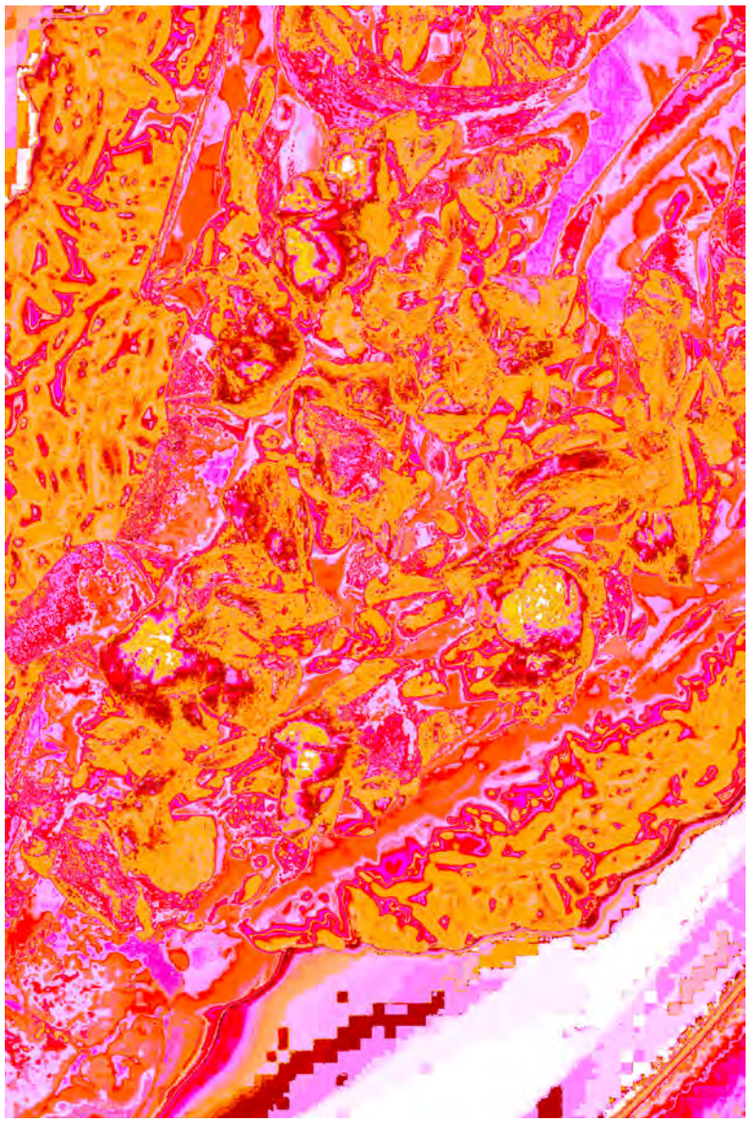


Photo by Boris Ulzibat
ΔL & Δa are constant
Δb randomized
ΔE = 18,8
ΔL & Δb are constant
Δa randomized
ΔE = 12

Photo by Alexander Afanasyev

ΔL constant
Δa & Δb randomized
ΔE = 23,4

ΔE = 0,5



ΔE = 49,4

ΔL & Δa are constant
Δb randomized
ΔE = 18

ΔL, Δa & Δb
are randomized

ΔL, Δa & Δb are randomized

Photo by Alpaslan Demir

ΔE = 0,5

Fogra 39L 300 Coated

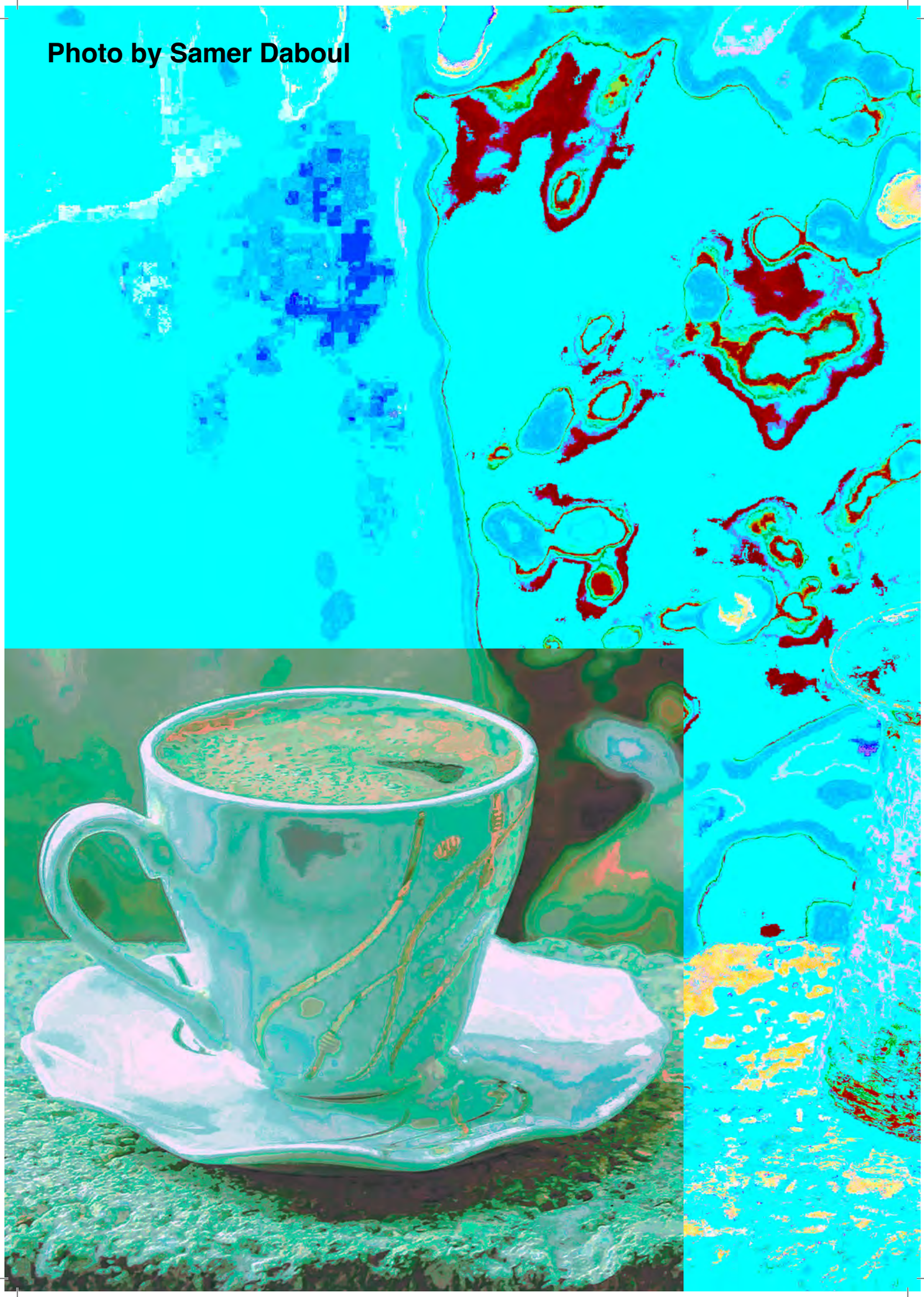
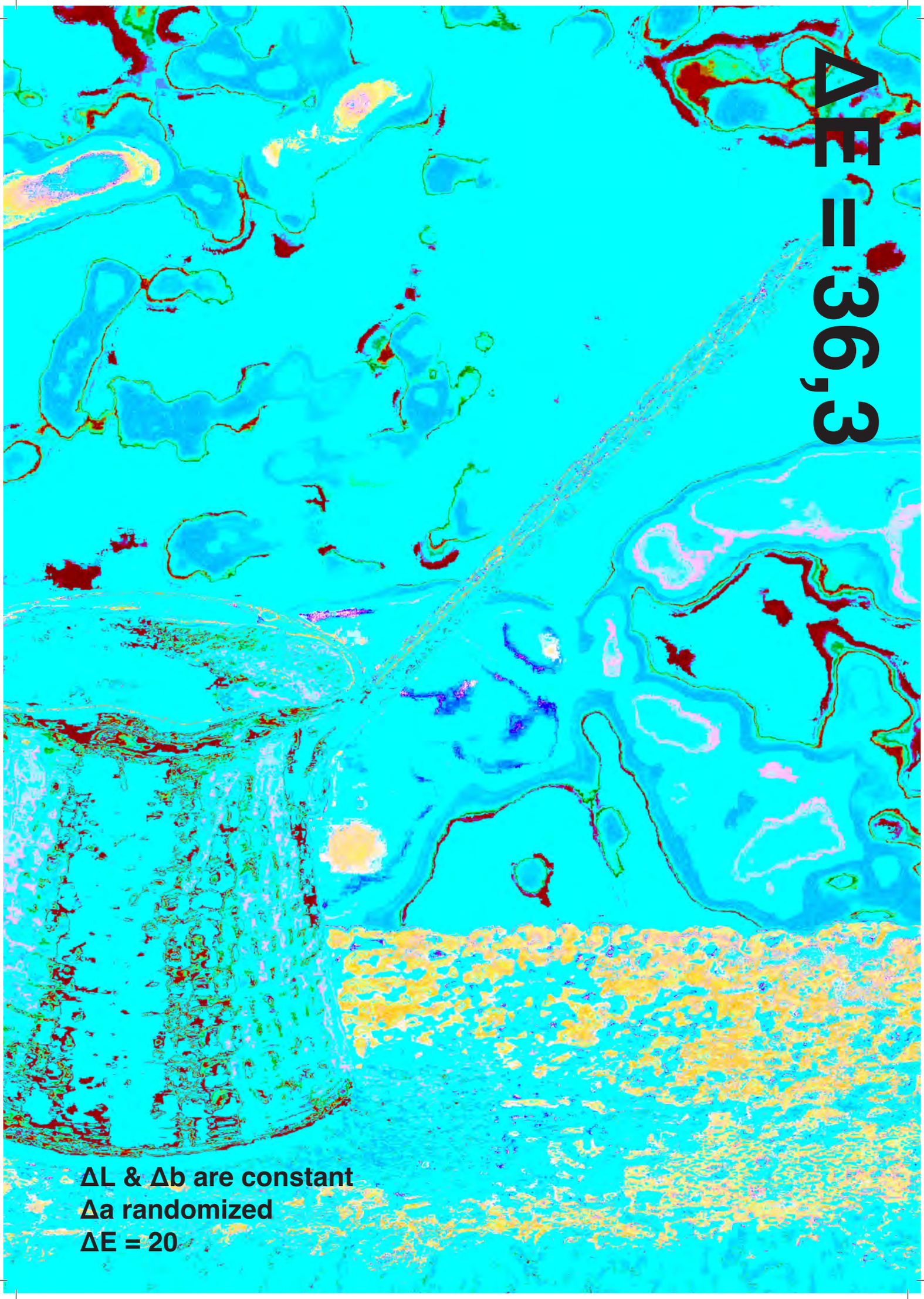
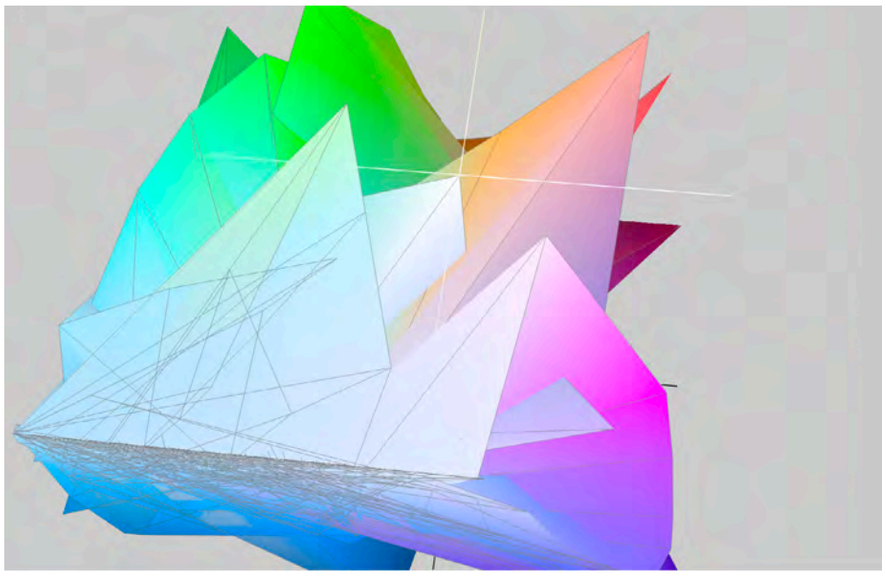


Photo by Samer Daboul

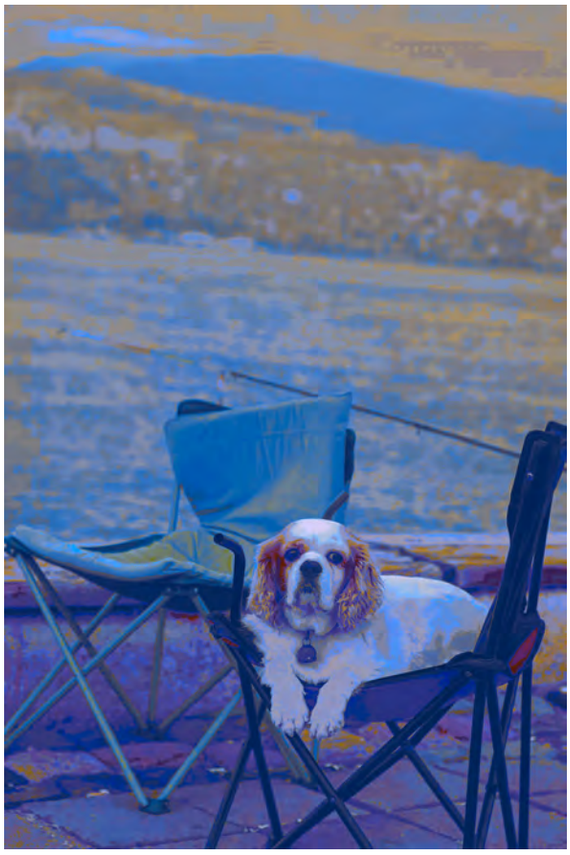

ΔE = 36,3
ΔL & Δb are constant
Δa randomized
ΔE = 20



3D Modeling a crazy gamut for Fogra 39L 300


ΔE=48,5
JapanColor2011
Coated

Photo by Kubra Kuzu



ΔL & Δa are constant
Δb randomized
ΔE = 26,6

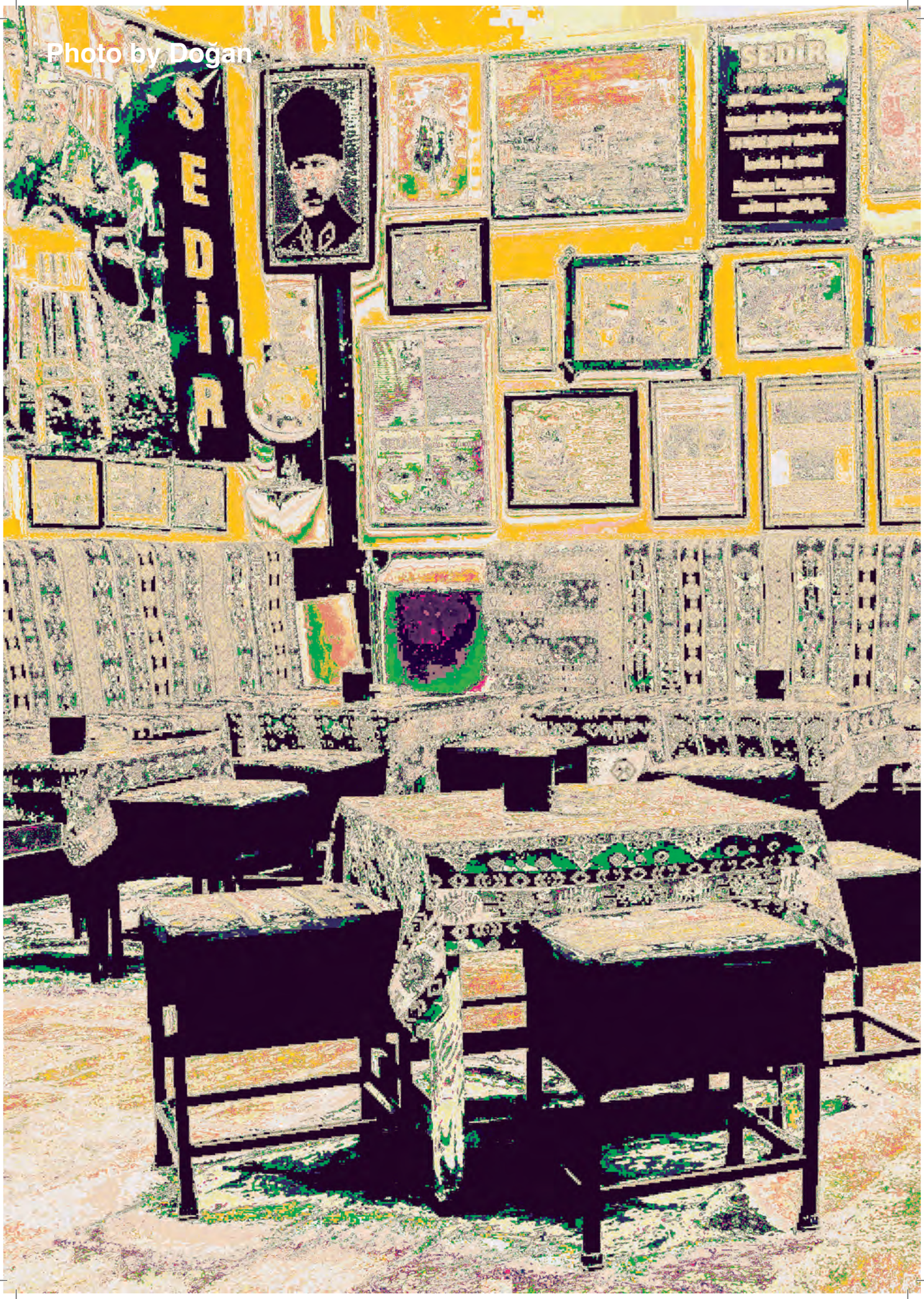
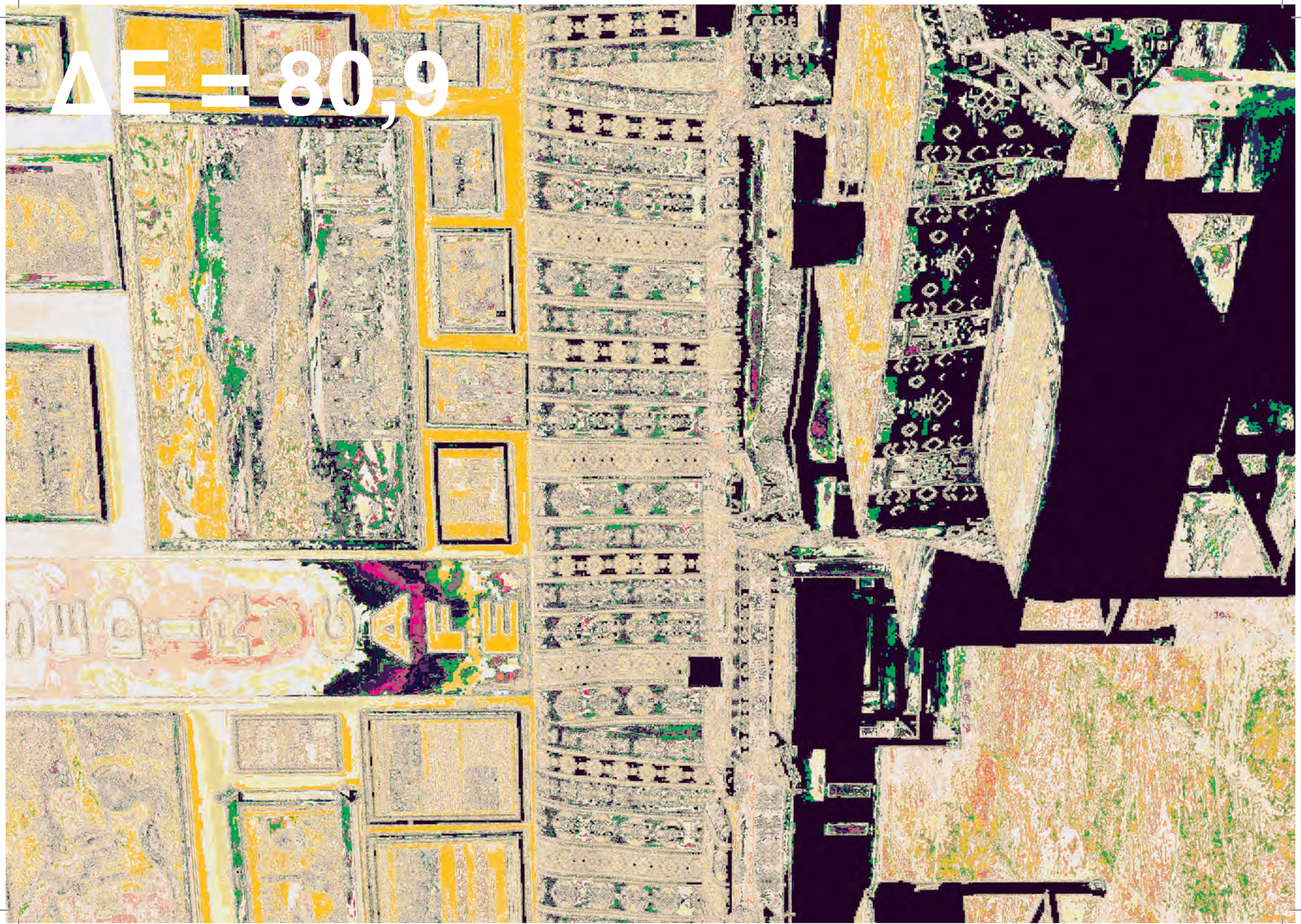


Photo by Doğan

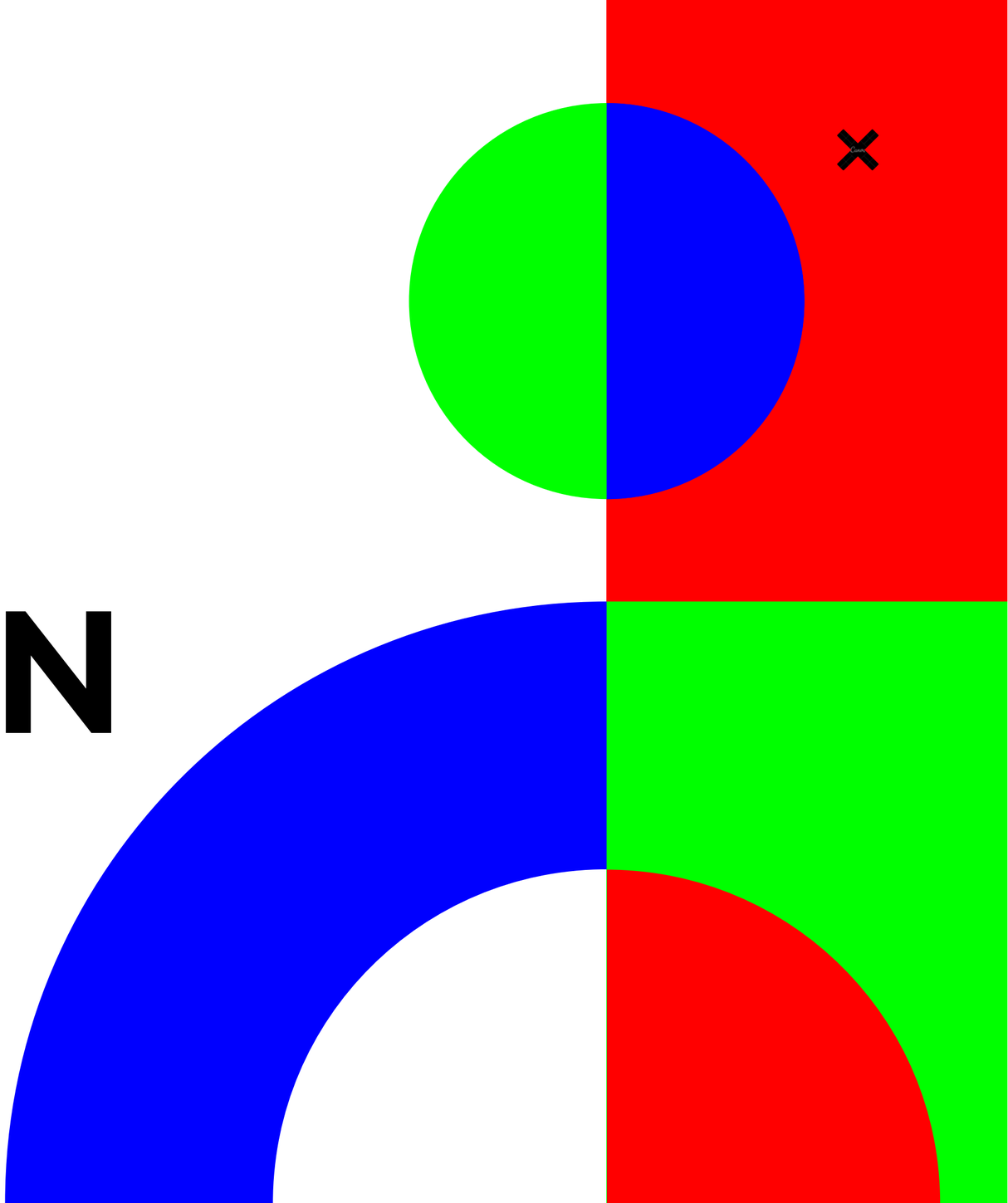

ΔE = 80,9

EPE

COLOR SEPARATION

ECRANPAPIEREDITER

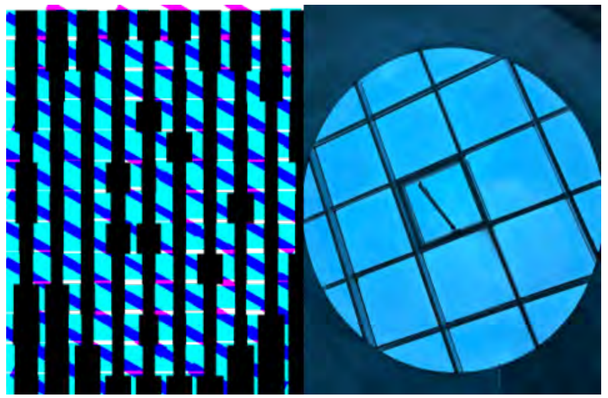
13.12.2024.



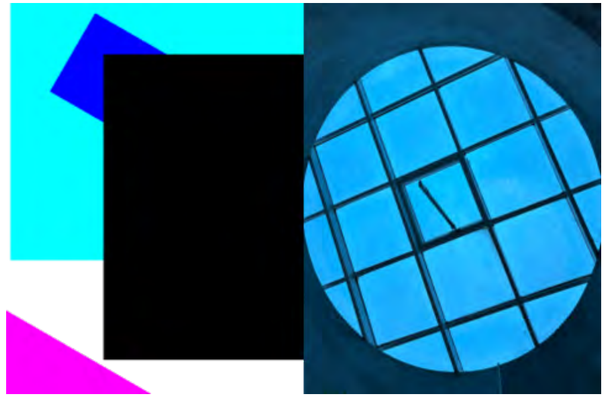
COLOR SEPARATION

COLOR SEPARATION IS THE PROCESS BY WHICH ORIGINAL FULL-COLOR DIGITAL FILES ARE SEPARATED INTO INDIVIDUAL COLOR COMPONENTS FOR FOUR-COLOR PROCESS PRINTING.

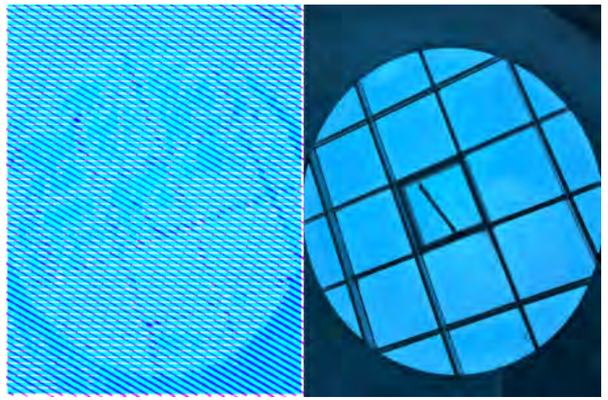
```
function draw() {
  clearRiso();
  // background(255);

  let dotSpace = 4

  let angle = 0
  let threshold = 255 - 55

  // possibilites are line, square, circle,
ellipse, cross

  let shape = 'line'
```



let dotSpace = 50

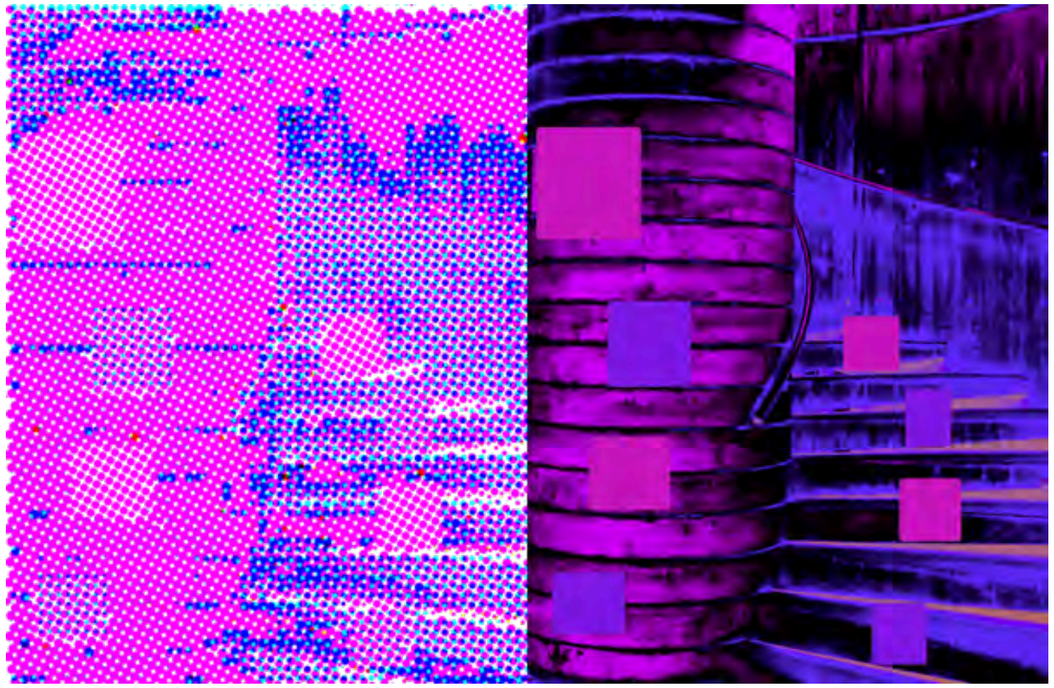


let dotSpace = 500

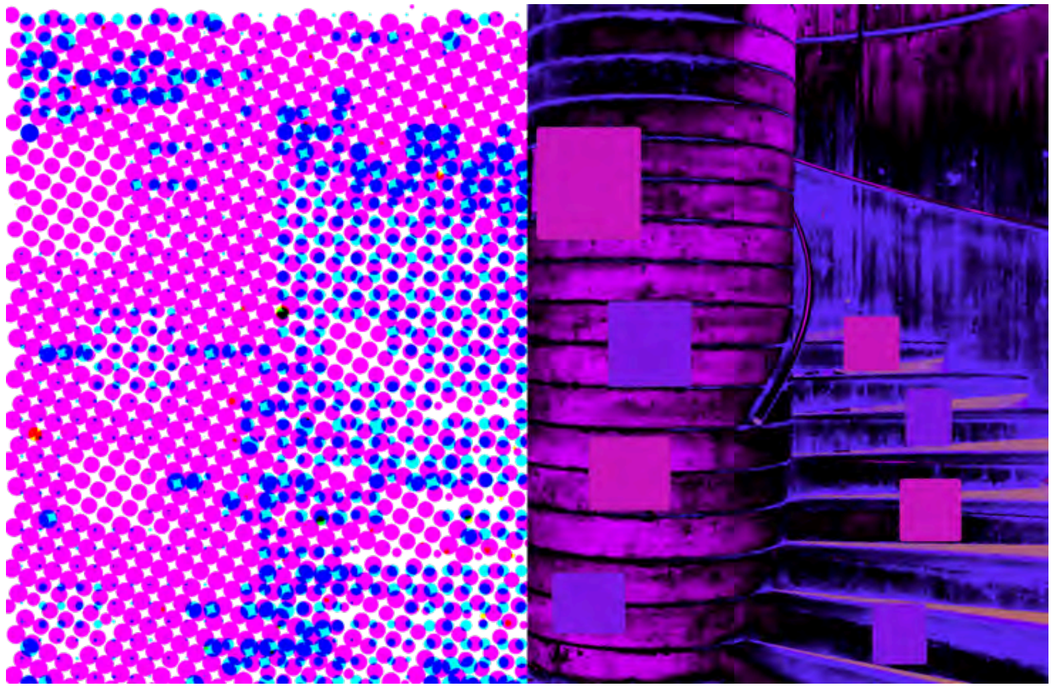


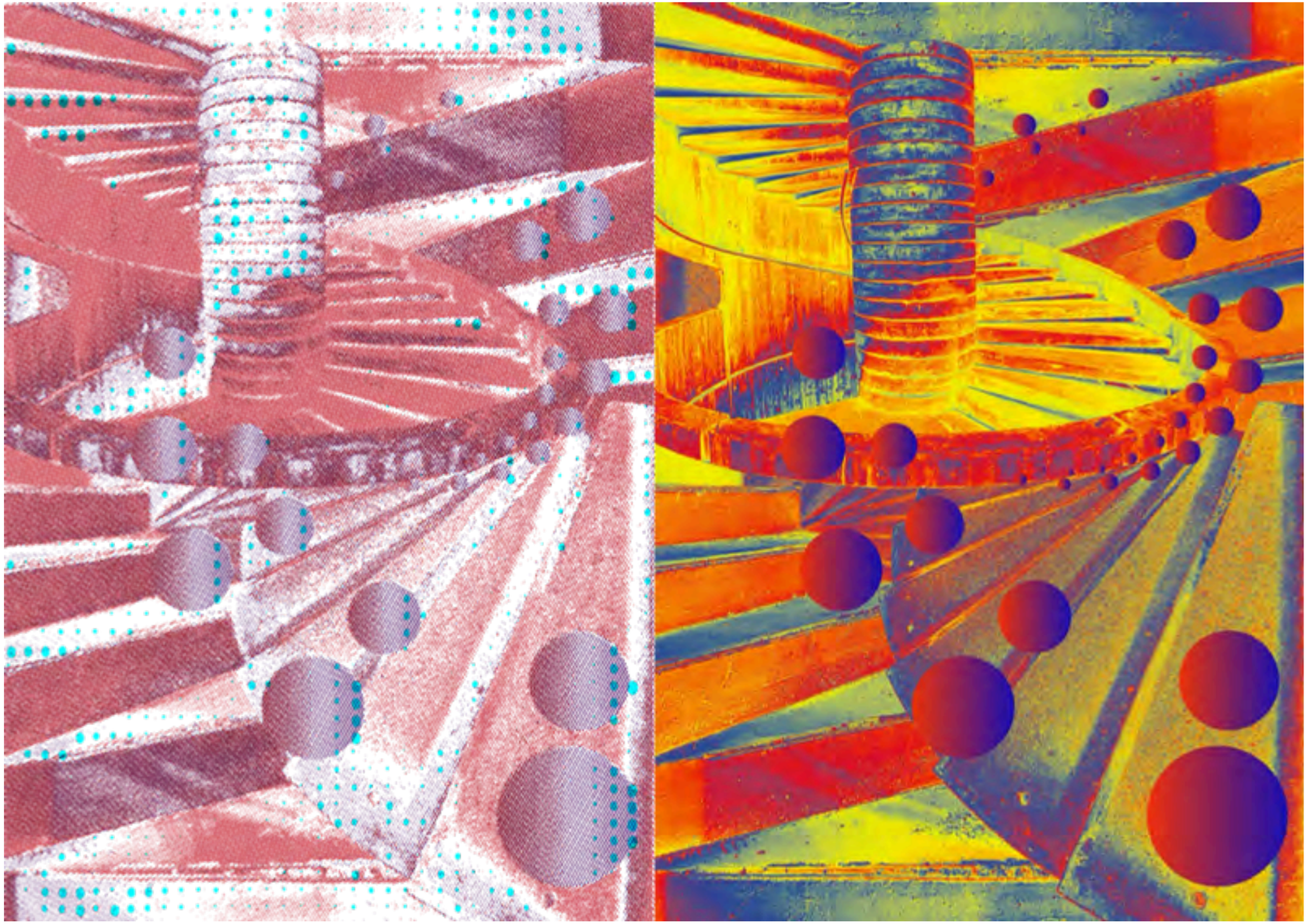
let dotSpace = 10

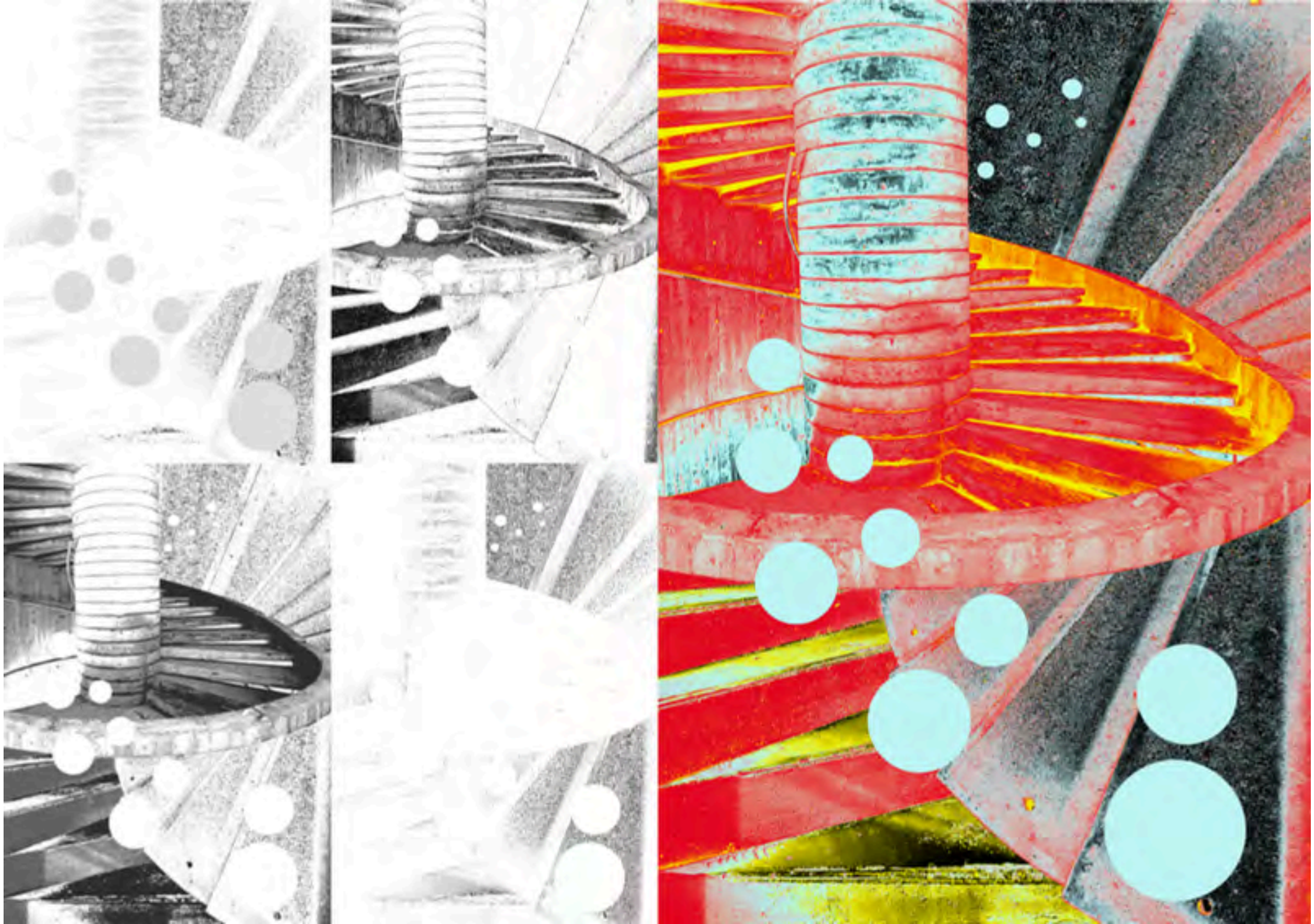
dot space = 20
angle = 0
threshold = 255-105
shape = circle



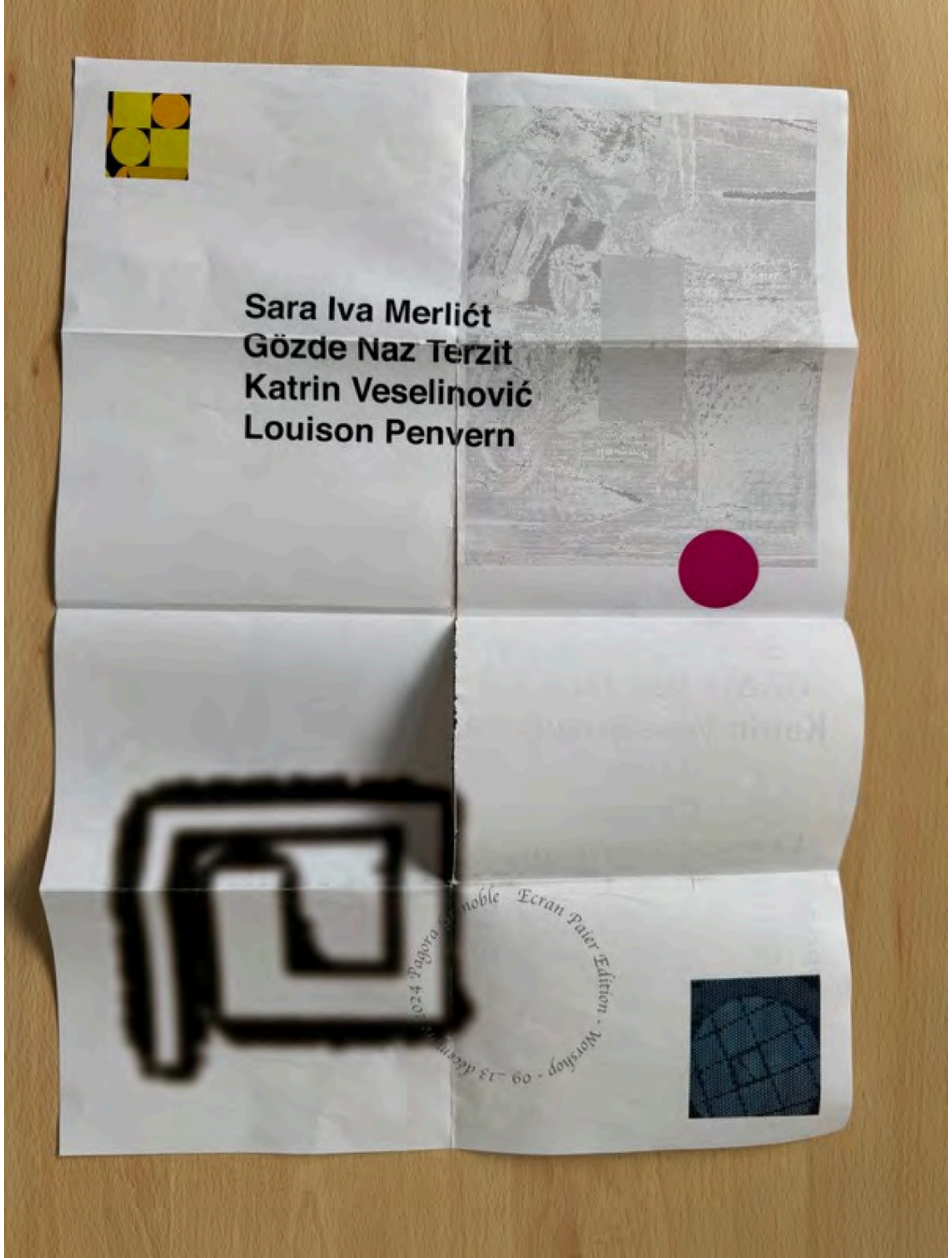
dot space = 40
angle = 0
threshold = 255-105
shape = circle

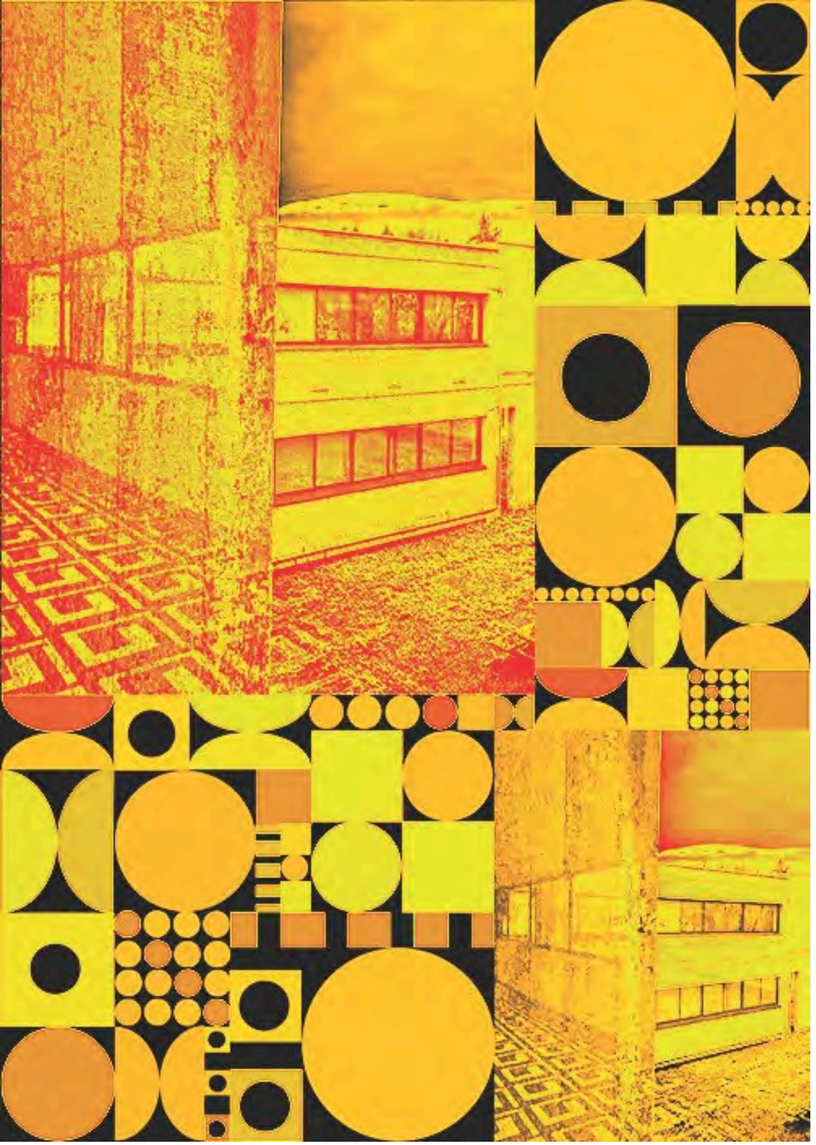


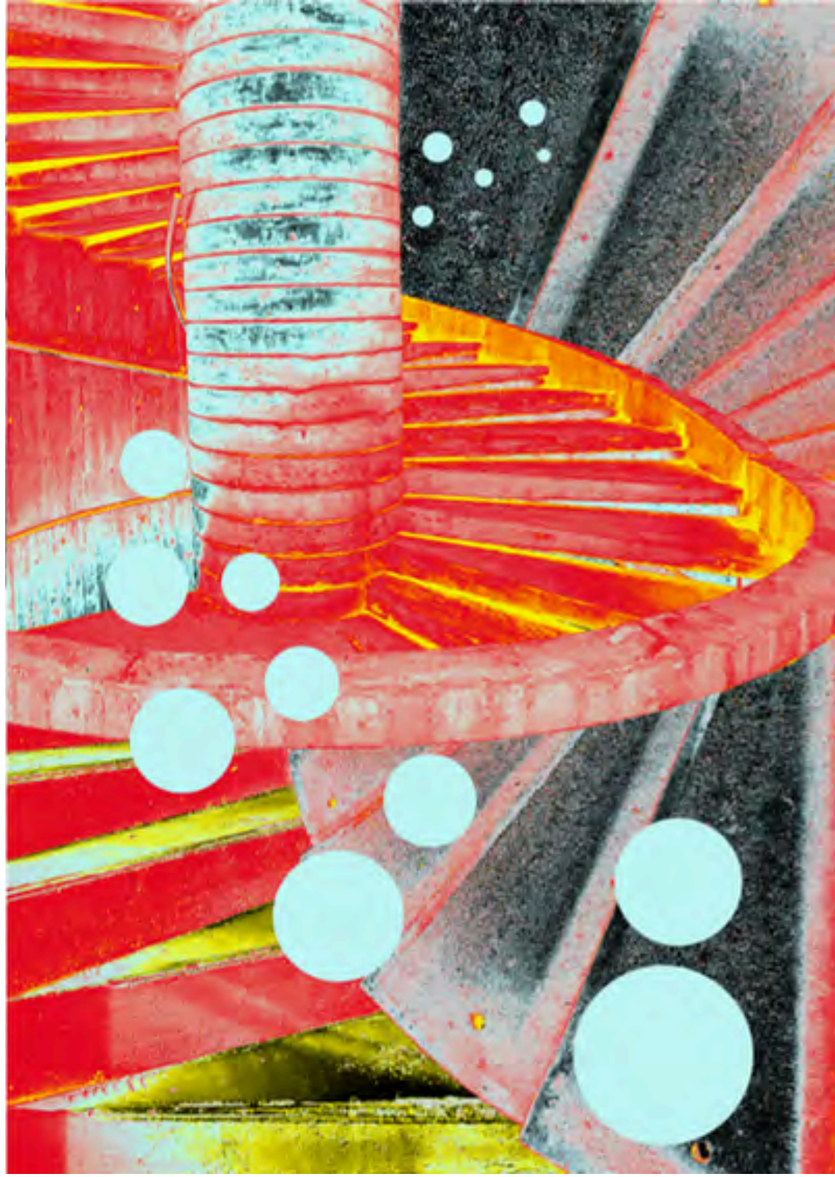


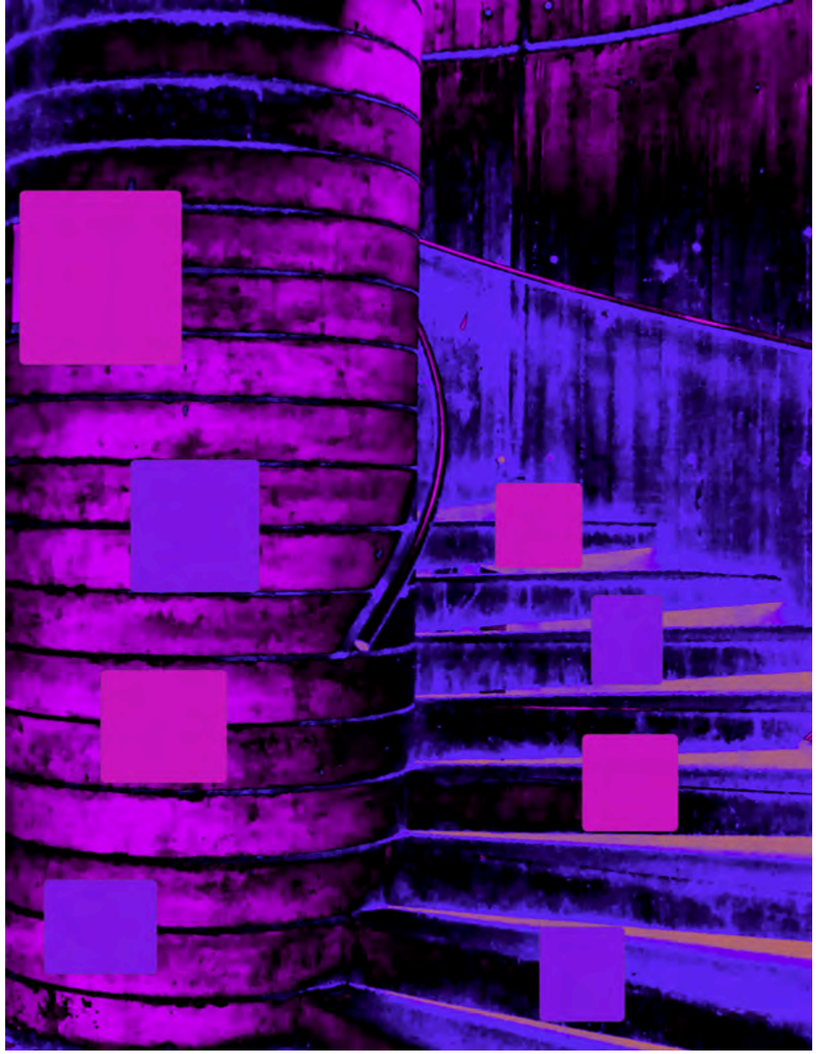



5
4
6
3
Sara Iva Merlić...2
Gözde Naz Terzi... 3
Katrin Veselinović... 4
Lucie
Coralie
Louison Penvern... 5
2
EPE
workshop
RGB color
separation
1


Sara Iva Merlićt
Gözde Naz Terzit
Katrin Veselinović
Louison Penvern
Ecran Paier Edition - Worshop - 09 - 13








EPE
WORKSHOP
PAGORA
09 — 13 DEC
GRENOBLE
color separation
Sara Iva Merlićt
Louison Penvern
Coralie Piedallu
Gözde Naz Terzit
Lucie Vautrin
Katrin Veselinović
Sara Iva Merlićt
ZAGREB
Louison Penvern
VALENCE
1
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Coralie Piedallu
Gözde Naz Terzi
Katrin Veselinović
Louison Penvern
Lucie Vautrin
Sara Iva Merlić

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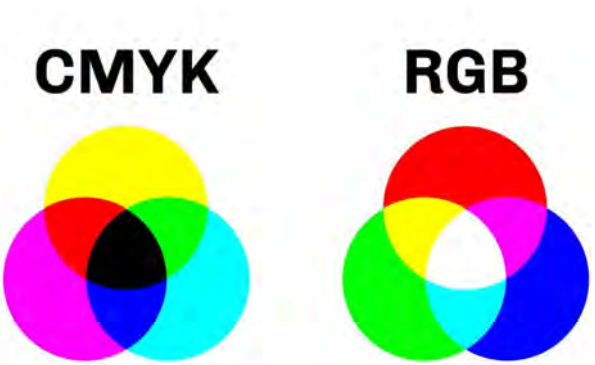
The EPE project is funded by the European Union (Cooperation Project - Creative Europe), which made this initiative possible and created a space for innovation learning and sharing.

Rapport technique génération de trame

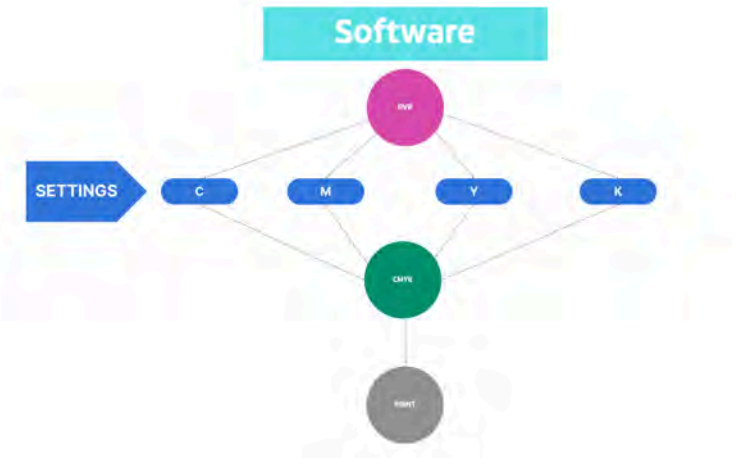
1/Mise en contexte

L'une des étapes les plus importantes dans l'impression moderne est le *tramage en quadrichromie* (CMYK : Cyan, Magenta, Jaune, Noir). Chaque couleur est séparée et tramée, et les différentes couches sont superposées lors de l'impression pour créer l'image finale.



2/Objectif

L'objectif de notre travail va être d'imaginer et de coder une interface nous permettant de séparer une image RVB en 4 couches CMYK. Puis d'appliquer différents types de tramage à ces différentes couches, de modifier des paramètres importants du tramage comme la linéature la forme des points la taille des points ou encore l'angle de trame. Enfin l'interface pourra reformer l'image en superposant les 4 couches préalablement modifiées. Cela nous permettra d'obtenir des visuels intéressants du point de vue du design.

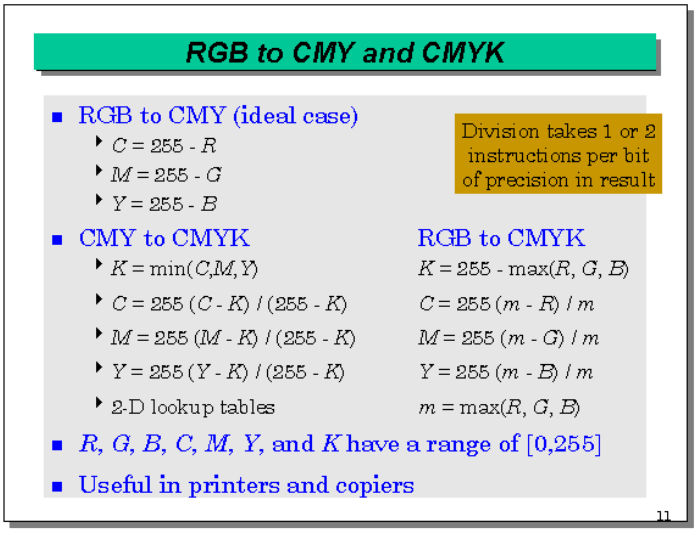


3/Le Processus du tramage

Il y a 3 types de génération de trame : la matrice de seuillage, des algorithmes examinant les points voisins ou des algorithmes itératifs.

3.1/Conversion de l'image en mode couleur puis séparation des couches

Avant d'appliquer le tramage, l'image est convertie en mode de couleur approprié pour l'impression. Pour une impression en quadrichromie, l'image est séparée en quatre couches: cyan, magenta, jaune et noir (CMYK).



3.2/Création de la trame numérique

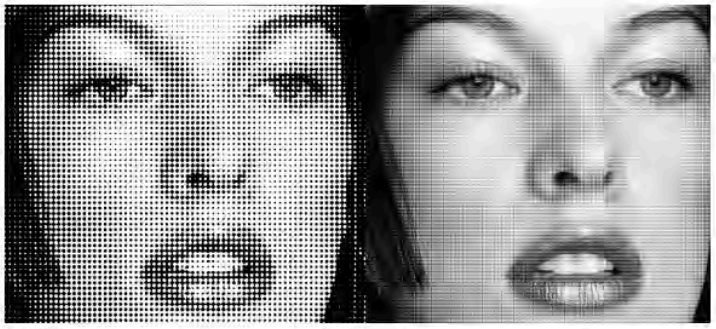
Il faut tout d'abord choisir la trame à utiliser puis la linéature adaptée au support et à la qualité demandée. Ensuite, il faut configurer le RIP (Raster Image Processor) en réglant plusieurs paramètres (type de tramage, linéature, forme des points) et en choisissant des angles de trame pour chaque couleur en quadrichromie.

4/Types de tramage

Il existe plusieurs types de tramage utilisés dans l'industrie de l'impression. Mais dans notre cas, pour pouvoir modifier et manipuler la trame comme on le souhaite dans l'interface, une seule type de trame va nous intéresser : la trame classique (AM)

4.2/Tramage AM (Amplitude Modulation)

Le tramage classique aussi nommé à modulation d'amplitude (AM) utilise des points espacés de la même distance et qui grossissent lorsque l'on imprime des tons sombres. Les impressions sont standards et de bonne qualité. De plus, les détails disparaissent pour les images avec beaucoup de lumière et d'ombre. Il dépend de la forme du point (ronds, elliptiques ou carrées), de la linéature avec des points générés alignés et de la taille du point qui va participer à la nuance de couleur à reproduire. Enfin, il dépend de l'orientation des lignes. Si plusieurs grilles se superposent, des effets de moirage et de rosette apparaissent.



effet linéature AM (cours lionel chagas)

5/ Paramètres clés du tramage

Dans notre interface, on veut pouvoir modifier plusieurs paramètres sur la trame afin d'obtenir des effets visuels intéressants sur le rendu final.

5.1/La linéature

Le tramage est caractérisé par sa linéature [2]. La linéature mesure l'espacement entre deux lignes de points. Elle s'exprime en lpi (Lines Per Inch) et indique la quantité de lignes sur une longueur de 1 pouce. On l'utilise pour mesurer la finesse de la trame. Une linéature fine est située entre 175 et 300 lpi alors qu'une linéature dite "grossière" est située entre 133 et 150 lpi. L'élargissement du point est aussi à prendre en compte. Il s'agit de la déformation que le point subit au cours de l'impression. Ce phénomène est maximal lorsque la circonférence du point est à 50% (pour un point de forme carrée par exemple).

5.2 L'angle de trame

L'angle de trame correspond à l'orientation de la grille de points. L'angle idéal varie selon les couleurs et est important pour éviter les effets de moiré, un phénomène visuel indésirable qui se produit lorsque les motifs de trame se superposent mal.

5.3/La forme et la taille des points

Les points peuvent prendre diverses formes : ronds, carrés, hexagonaux, etc. Chaque forme a des effets différents sur la texture de l'image imprimée. La taille des points dépend de la résolution du périphérique d'impression.

5.4/Choix du type de trame

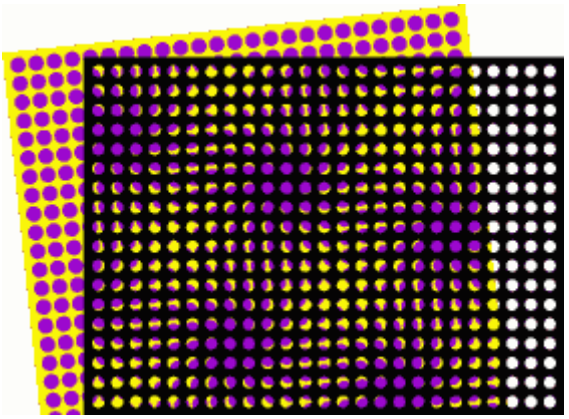
Le choix du type de trame dépend de la capacité des équipements et des contraintes de production (vitesse, coût…). Par exemple, pour un papier couché, une trame fine est plus

adaptée tandis que pour les papiers non couchés, il faut une trame grossière pour éviter que les points s'élargissent.

6/Effets visuels intéressants

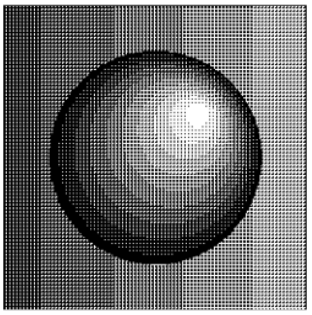
6.1/Effet de moiré

L'effet de Moiré, connu depuis l'antiquité, apparaît lorsque deux ou plusieurs couches ayant chacune une fréquence caractéristique sont superposées. Dans le cas de l'imagerie couleur, en quadrichromie notamment, lorsque chaque couleur de base est décomposée en quatre composantes principales, cyan, magenta, jaune et noir, l'effet de Moiré peut s'avérer très néfaste.
Dans la quadrichromie traditionnelle, la solution adoptée consiste en l'utilisation de la même fréquence de trame pour les quatres couches colorées séparées. L'orientation des couches habituellement utilisée est la suivante: 15° pour le cyan, 75° pour le magenta, 0° pour le jaune et 45° pour le noir.



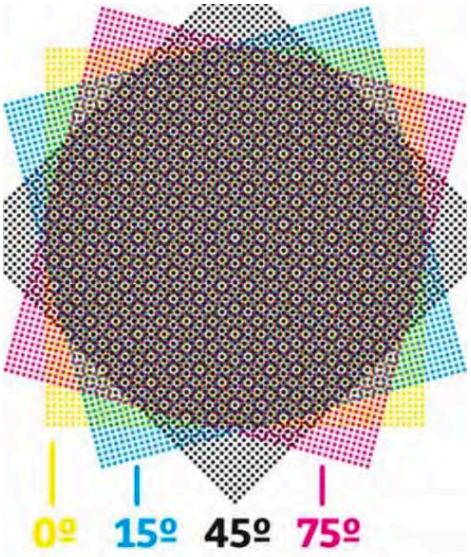
6.1/Effet de bande

L'effet de bande est un autre artefact gênant qui est lié à la nature discrète de la grille de sortie. Imaginons que S est la superficie d'un élément de trame utilisé pour la reproduction. Il est bien évident que, si la trame est parfaitement répétitive, il n'existe que S + 1 possibilité de reproduire des niveaux d'intensité différents: 0 lorsque toutes les cases de l'élément de trame sont noires, 1 lorsqu'une des cases est blanchie, etc. jusqu'à S lorsque toutes les cases sont blanchies. Ainsi, on obtient S + 1 niveaux d'intensité différents.



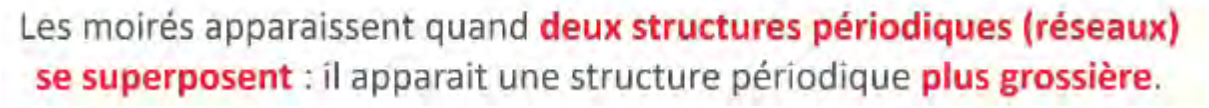
6.2/Rosette

Sur un tramage classique, lorsque les trames de couleur sont superposées avec des angles appropriés et que la linéature des trames est identique pour toutes les couleurs alors, des rosettes apparaissent. Elles aident à minimiser les effets de moiré et rendent l'image plus stable visuellement.



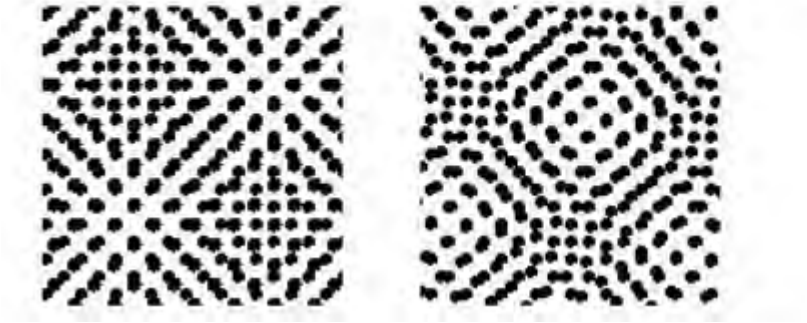
6.3/Autres

Effets de Moiré dans une trame AM (modulation d'amplitude des points)

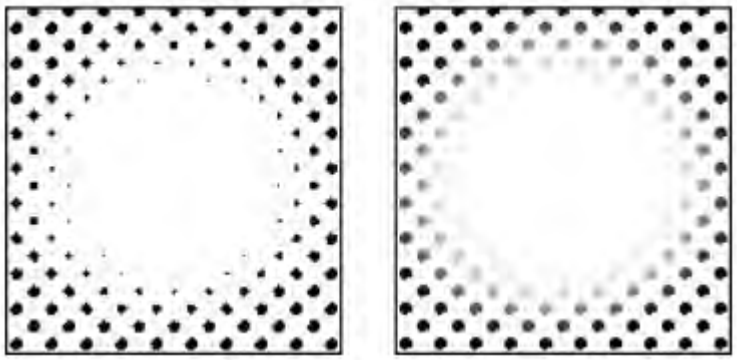


Moiré apparaît lorsqu'on superpose des trames avec une linéature ou angle de trame différent (mais pas trop non plus). Exemple pour 2 trames :

Gauche : Superposition de trames de 50 et 60 lignes
Droite : Superposition de trames à angle de 45 et 50 degrés



A l’impression : cet effet est réduit pour une trame noire, et augmenté pour des points gris.

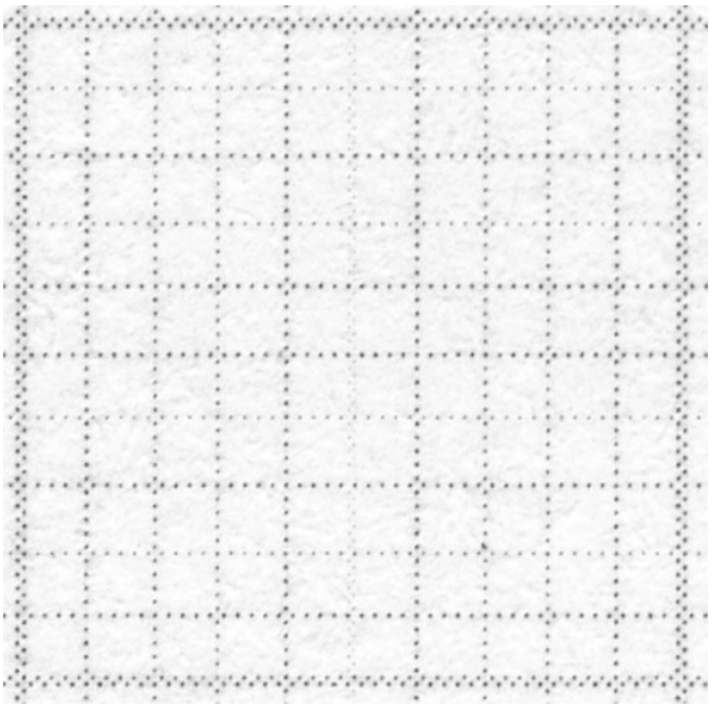


Effet apparaît lorsqu'on diminue la taille de l’image, sans diminuer la taille des points..

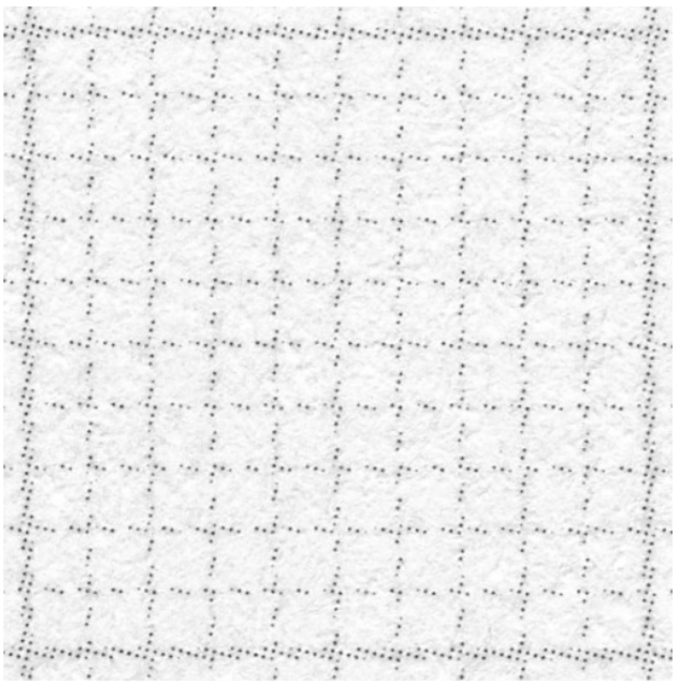
Apparaît aussi lorsqu’on a un motif répétitif dans l’image (chemise à carreaux, motifs fins, etc…)

Aucun moiré ne se produit si :

- Le motif est imprimé suffisamment grand, par exemple sur un mur de salon, pour qu'il n'y ait pas de superposition de trames. La trame d'impression est suffisamment fine pour reproduire entièrement la trame de l'image.
- le motif est imprimé suffisamment petit pour qu'il n'y ait pas de superposition de trames. Si la chemise à carreaux est imprimée si petite qu'aucun carreau ne peut être reproduit, il n'y aura pas de moiré.
- est imprimée dans la trame à modulation de fréquence. Si la trame est répartie de manière apparemment chaotique sur la page, les chances de superposition sont considérablement réduites.



Détail moiré Angle de trame de 45° Trame de 70



Détail moiré Angle de trame de 15° Trame de 80

Pour faire apparaître volontairement un effet de moiré, vous pouvez suivre ces méthodes :

1. Superposition de grilles :
    - Utilisez deux grilles déployé de tailles différentes.
    - Placez-les parallèlement l'une à l'autre, en les faisant se toucher à une extrémité.
    - Ajustez la distance et l'angle entre les grilles.
    - Faites passer une source lumineuse à travers les grilles.
2. Création numérique avec Illustrator :
    - Dessinez une forme de base (par exemple, un cœur).
    - Dupliquez cette forme plusieurs fois.

    - Utilisez l'outil "Transformation" pour créer des étapes intermédiaires entre les formes.
    - Ajustez le nombre d'étapes (20 ou plus) pour obtenir l'effet désiré.
3. Superposition de motifs :
    - Créez deux ensembles de lignes ou de grilles similaires.
    - Superposez-les avec un léger décalage ou une rotation.
    - Ajustez l'espacement et l'angle pour varier l'effet.
4. Techniques photographiques :
    - Photographiez un écran LED ou un motif répétitif.
    - Ajustez la distance et l'angle de la caméra par rapport au sujet.
    - Expérimentez avec différentes focales et ouvertures.

Pour intensifier l'effet :

- Variez la distance entre les motifs superposés.
- Utilisez des sources lumineuses colorées ou multiples.
- Expérimentez avec différentes textures et tailles de grilles ou de motifs.

L'effet de moiré peut créer des motifs géométriques saisissants et des illusions d'optique intéressantes, utiles dans l'art et le design

Prototyping workshop#1 @Pagora Grenoble

13/12/2024

Zagreb team

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Ema Lovrić	Présent
Rebeka Šćulac	Rebeka Šćulac
Filip Marjanović	Présent
Katrin Veselinović	Katrin Veselinović

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Daniele Savasta	Présent
Berke Çınarlı	
Gözde Naz Terzi	
Oğuz Ülgen Tunç	
Muzafer Demireva	
Ayşe Rana Sermet	

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Hugo Lopez	Présent.
Andrea Kevorkian	
Seyedhossein Mousavi	
Mathis Curcio	

Melissa Bafou

Lorene Debenath.

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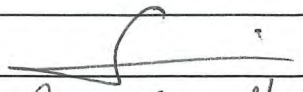
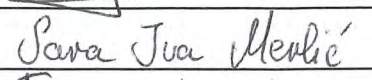
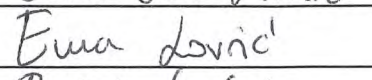
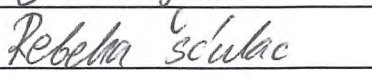
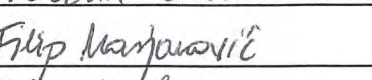
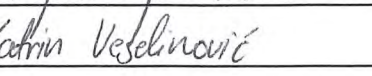
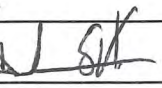
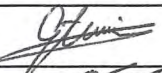
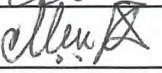
11/12/2024

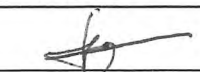
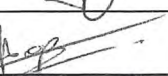
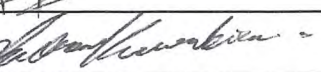
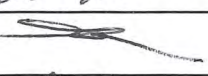
Zagreb team

Tomislav Cigula	
Sara Iva Merlić	
Ema Lovrić	
Rebeka Šćulac	
Filip Marjanović	
Katrin Veselinović	

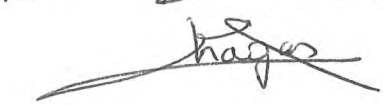
Izmir Team

Gokhan Mura	
Daniele Savasta	
Berke Çınarlı	
Gözde Naz Terzi	
Oğuz Ülgen Tunç	
Muzafer Demireva	
Ayşe Rana Sermet	

Valence Team

Dominique Cunin	
Romain Laurent	
Raphael Bottura	Présent
Louison Penvern	
Hugo Lopez	
Andrea Kevorkian	
Seyedhossein Mousavi	
Mathis Curcio	

Nadège REVERDY-BRUAS 

Lionel CHAGAS 

Prototyping workshop#1 @Pagora Grenoble

10/12/2024

Zagreb team

Tomislav Cigula	
Sara Iva Merlić	
Ema Lovrić	
Rebeka Šćulac	
Filip Marjanović	
Katrin Veselinović	

Izmir Team

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Daniele Savasta	
Berke Çınarlı	
Gözde Naz Terzi	
Oğuz Ülgen Tunç	
Muzafer Demireva	
Ayşe Rana Sermet	

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Louison Penvern	
Hugo Lopez	
Andrea Kevorkian	
Seyedhossein Mousavi	
Mathis Curcio	

Nadège Reverdy-Bruas

Lionel Ottagas

Lundi 9/12/2024

Prototyping workshop#1 @Pagora Grenoble

Zagreb team

Tomislav Cigula

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Katrin Veselinović

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Raphael Bottura

Louison Penvern

Hugo Lopez

Andrea Kevorkian

Seyedhossein Mousavi

Mathis Curcio

Daniel James-Appel

VEYDARIER

Neews feed from Pagora's team

4th workshop of the EPE project

Students of the University of Zagreb Faculty of Graphic Arts, Sara Iva Merlić, Ema Lovrić, Rebeka Šćulac, Filip Marjanović and Katrin Veselinović, and assoc. prof. Tomislav Cigula were participating in 4th workshop of the EPE project (more about the project can be seen on https://epe.esad-gv.fr/). The workshop was held from December 9th. – 13th, 2024. at Pagora (School of Paper and Printed Communication Engineering, INPG) in Grenoble, France. Students and teachers from four partner institutions ESAD GV (École Supérieure d'Art et Design de Grenoble/Valence), İzmir University of Economics, Department of Visual Communication Design, Turkey, our faculty and the host, Pagora were participating in this workshop.
During the first day, teachers and students from the host institution have showed guests the facility and the basics of print reproduction with an emphasis on colour management and screening techniques. On the second day, practical exercises were conducted to create ICC profiles for various printing substrates and two digital printing presses. After this introduction about the key topics of the workshop, the students were divided into four international groups, each of which had its own topic: inclusion and experimentation with ICC profiles, simulation/experimentation with different screening parameters, experimentation with colour separations, and creation of a software solution for visualizing screening changes.
On the last day, a presentation of the developed solutions was organized, followed by a discussion about the workshop and future steps.

Participation in this workshop allowed students, as well as teachers, to gain valuable experience in solving project tasks that they had not encountered before, and to collaborate within an international group of students with different prior knowledge, approach to the topic, and communication skills.

A few photos from the workshop:


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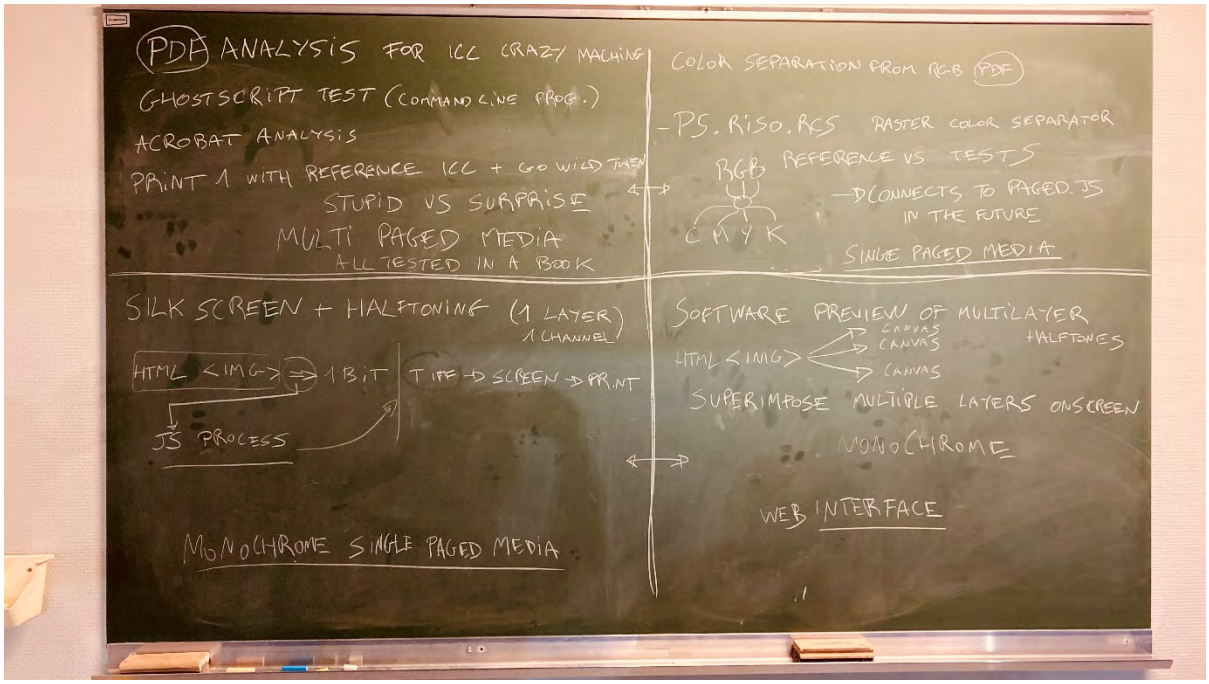
SOURCES


PDF ANALYSIS FOR ICC CRAZY MACHINE
GHOSTSCRIPT TEST (COMMAND LINE PROG.)
ACROBAT ANALYSIS
PRINT 1 WITH REFERENCE ICC + GO WILD THEN
STUPID VS SURPRISE
MULTI PAGED MEDIA
ALL TESTED IN A BOOK
COLOR SEPARATION FROM RGB (PDF)
-PS. Riso. RCS RASTER COLOR SEPARATOR
RGB REFERENCE VS TESTS
CMYK
-> CONNECTS TO PAGED.JS IN THE FUTURE
SINGLE PAGED MEDIA
SILK SCREEN + HALFTONING (1 LAYER / 1 CHANNEL)
HTML <IMG> => 1 BIT
TIFF -> SCREEN -> PRINT
JS PROCESS
MONOCHROME SINGLE PAGED MEDIA
SOFTWARE PREVIEW OF MULTILAYER HALFTONES
HTML <IMG> CANVAS CANVAS CANVAS
SUPERIMPOSE MULTIPLE LAYERS ONSCREEN
MONOCHROME
WEB INTERFACE


CRAZY MACHINE


PARIS