AVT-371 Research Workshop on

"Materials and technologies for electro-optical camouflage"

Adaptive camouflage using innovative display technology and algorithms

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BUNDESWEHR

Adaptive camouflage

- **Principle**

Adaptive camouflage

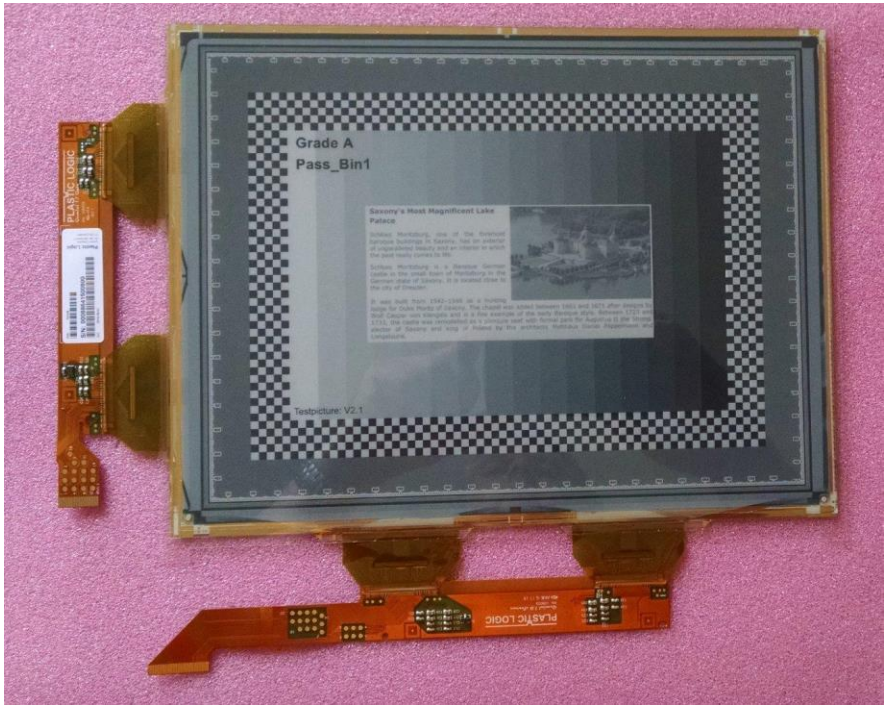
- **Key problems**

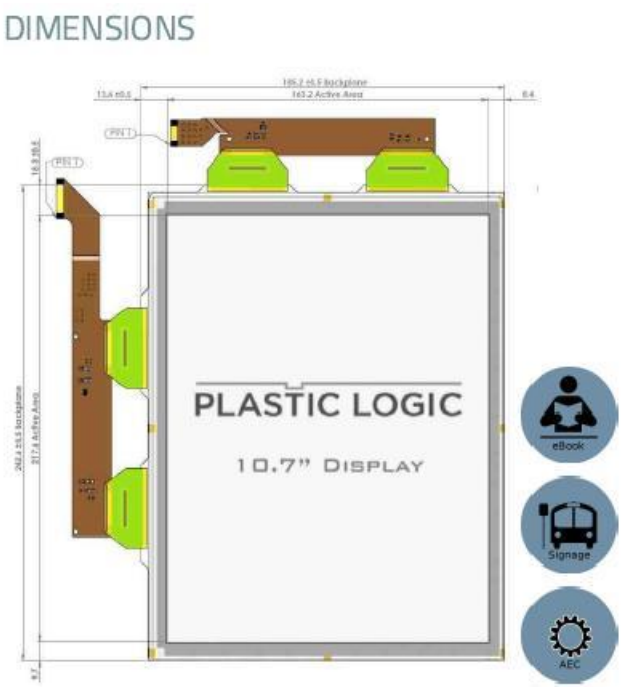
Adaptive camouflage

- Technologies
- Algorithms
- Demonstration

Passive display technologies

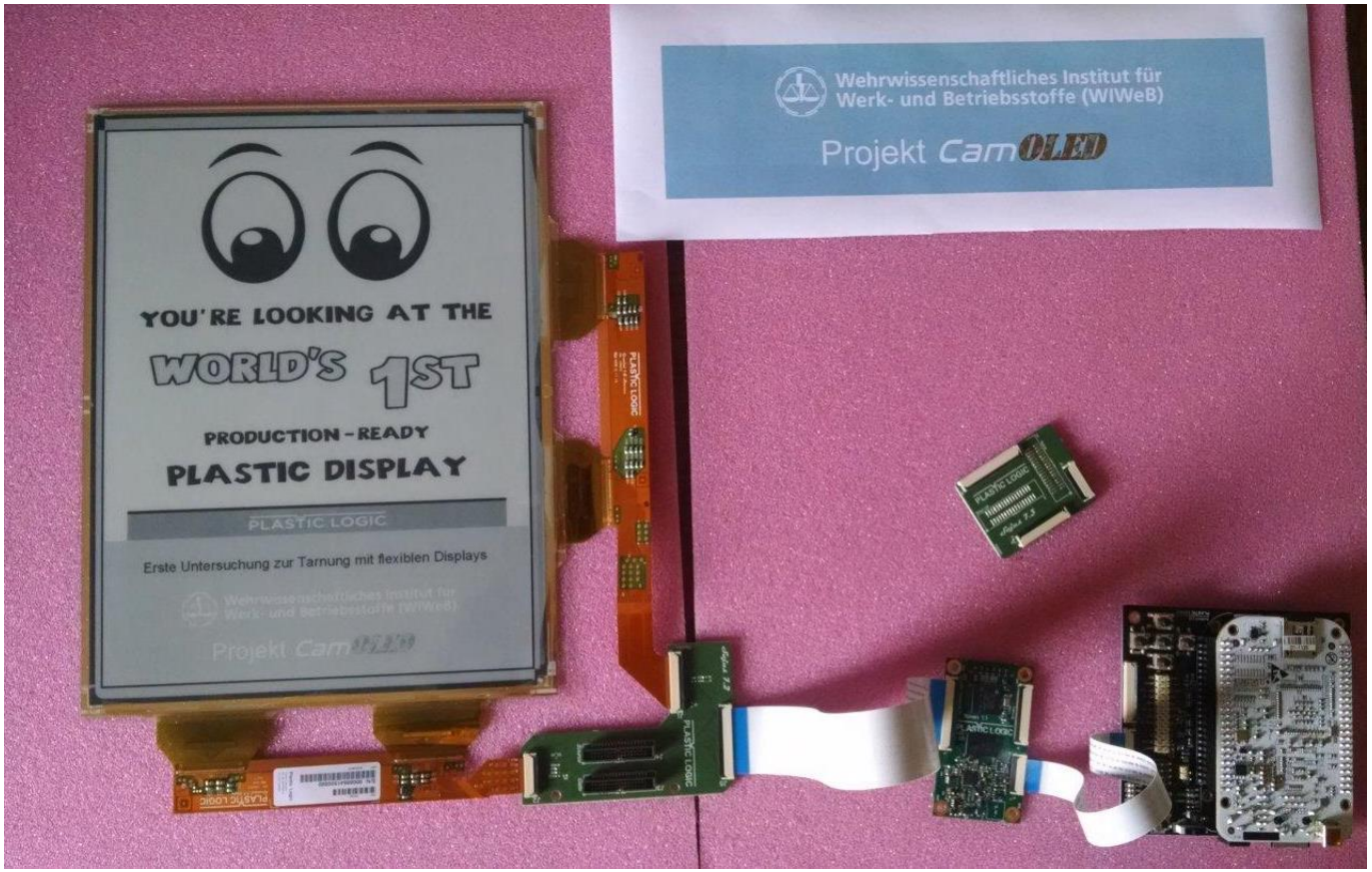
Passive display technologies





Passive flexible display from company Plastic Logic on plastic base

Passive display technologies



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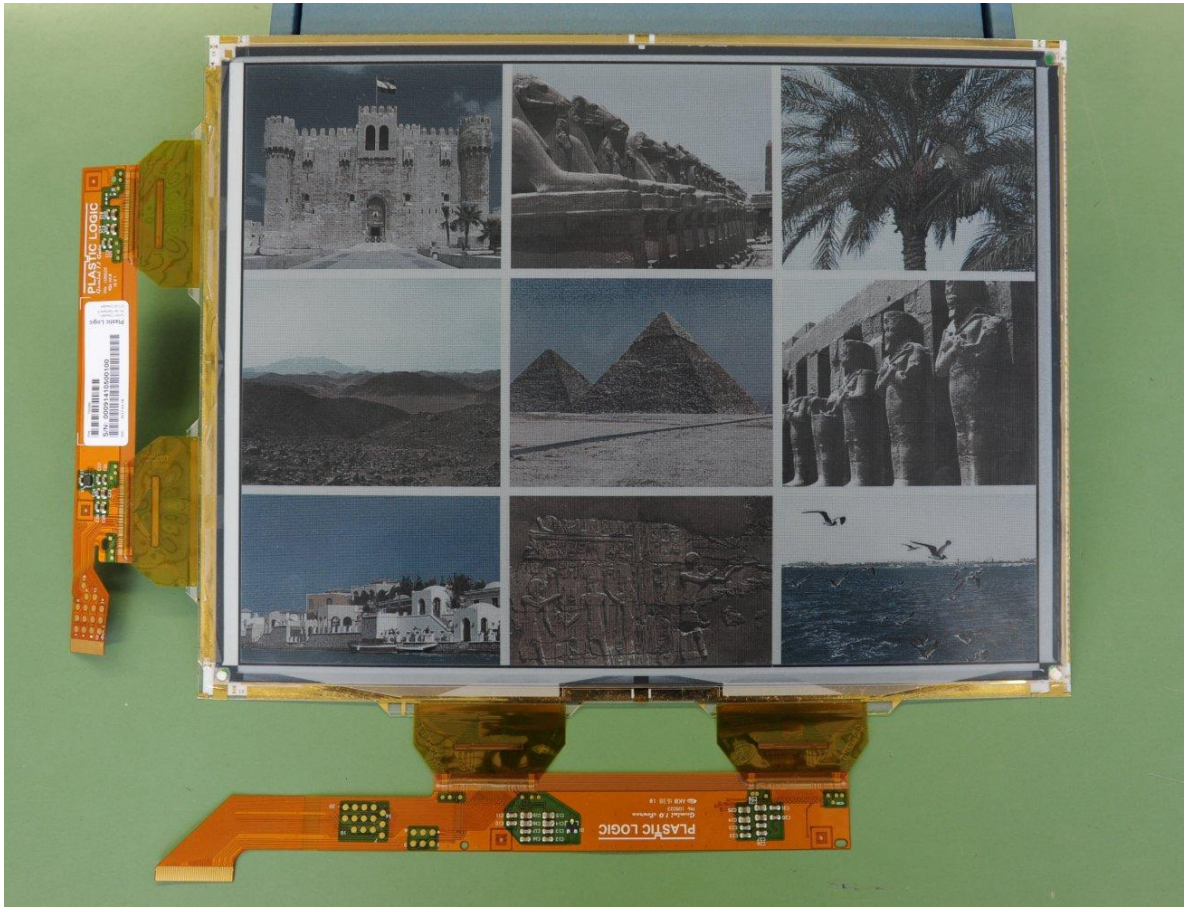

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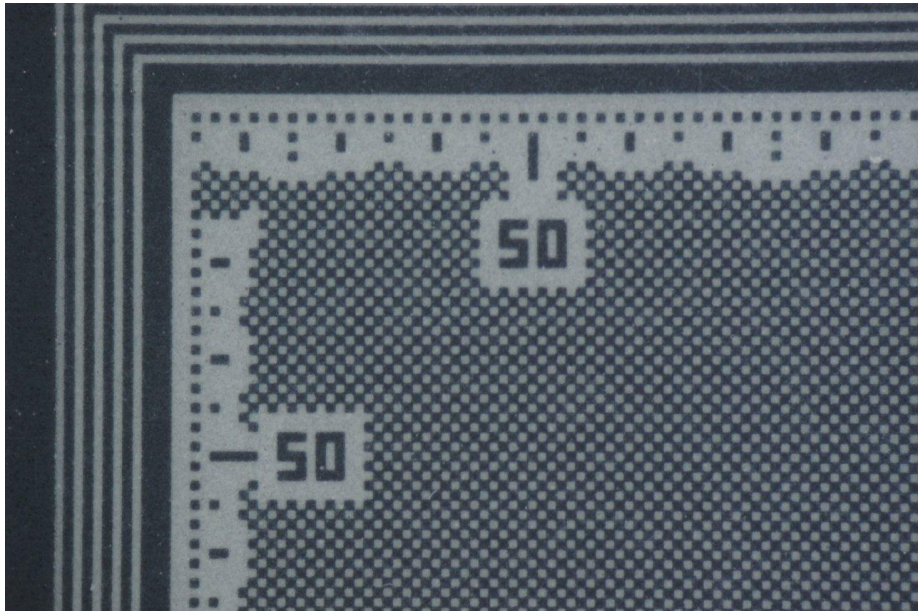

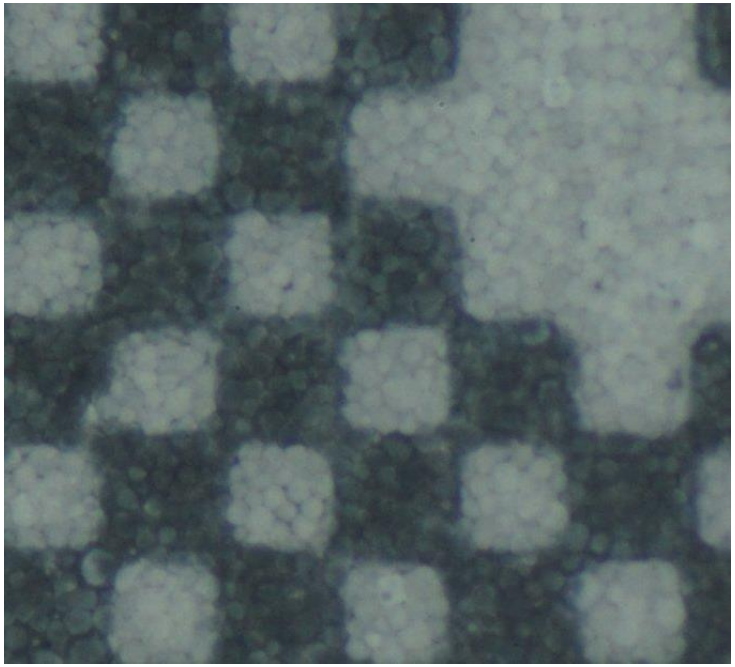

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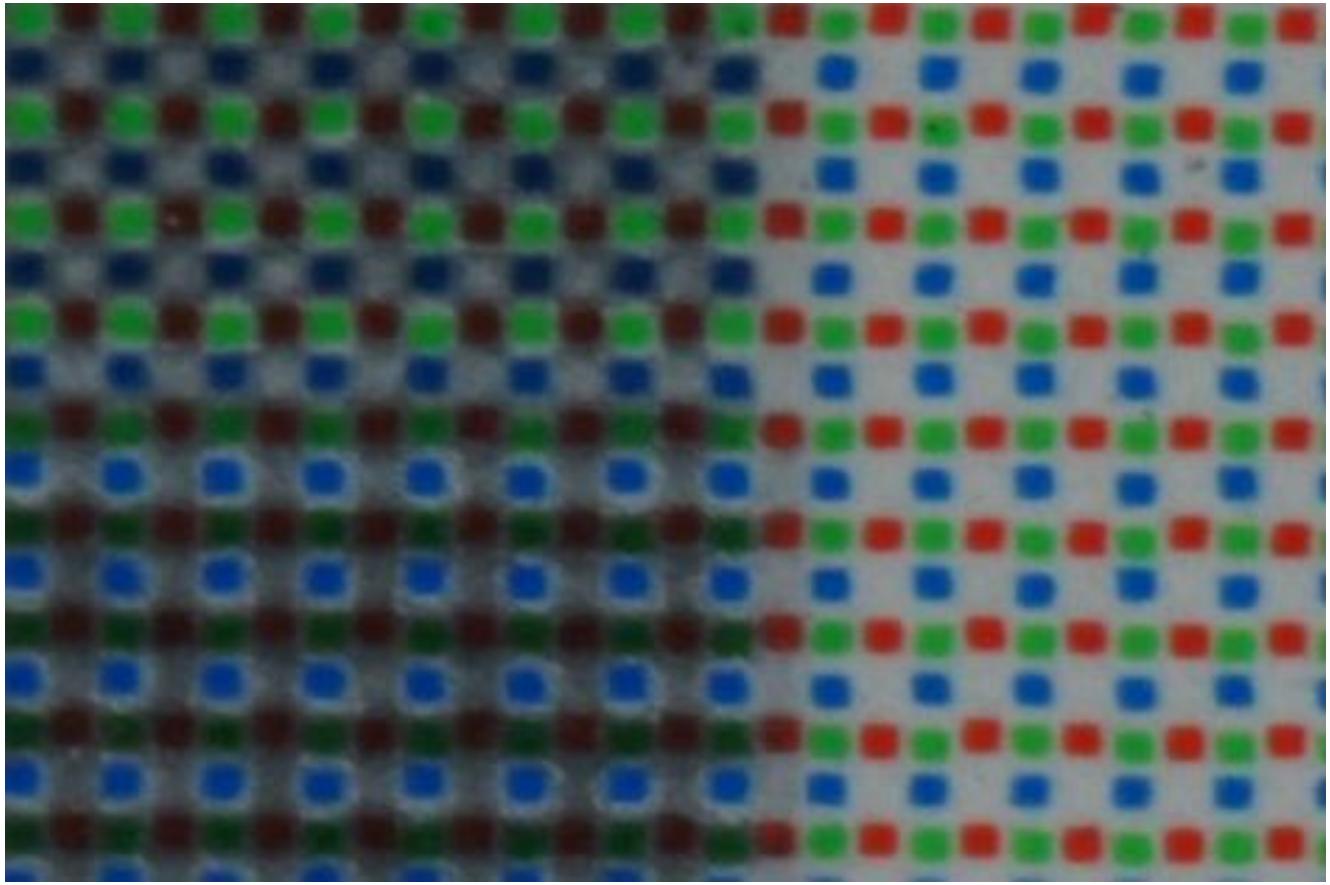

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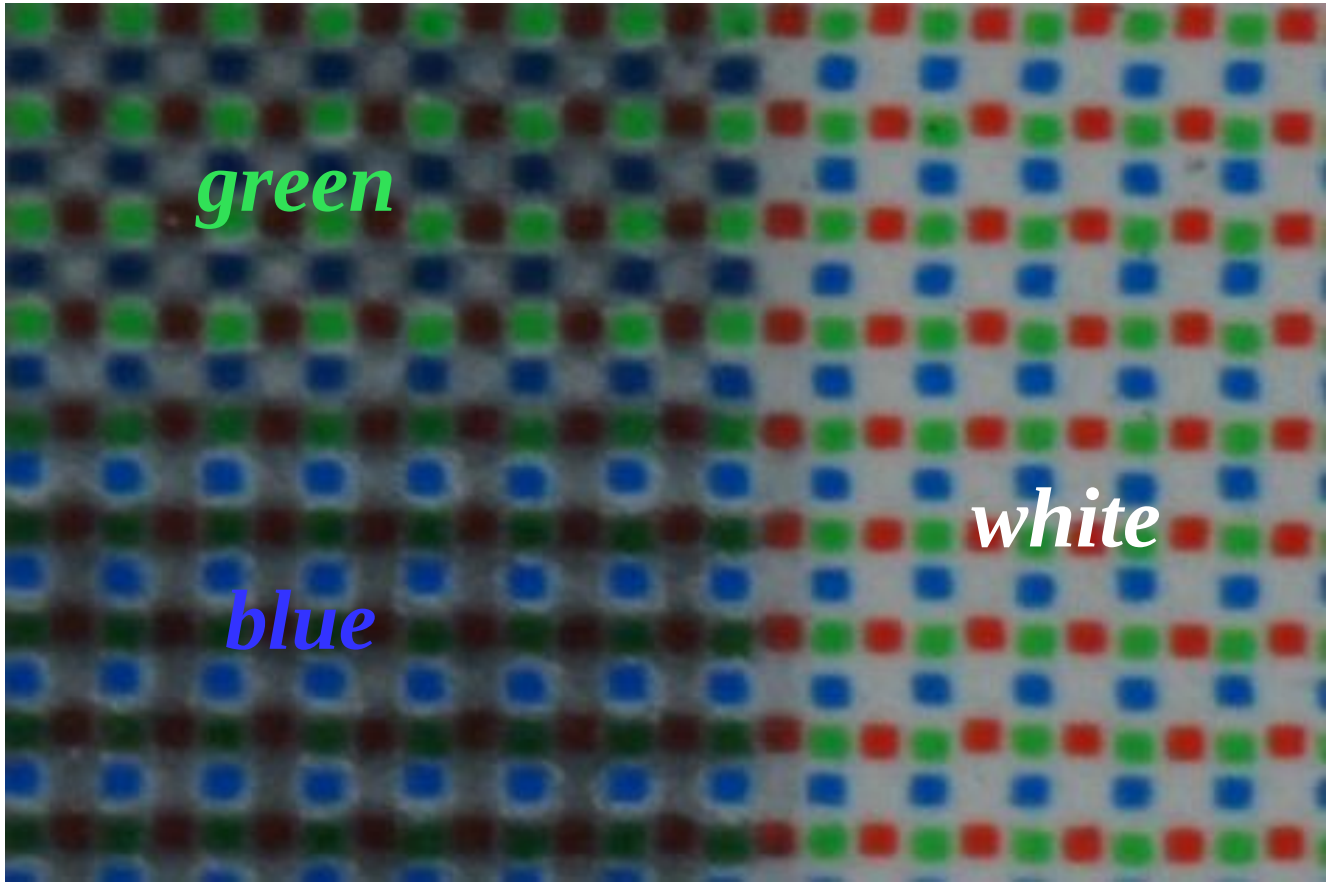
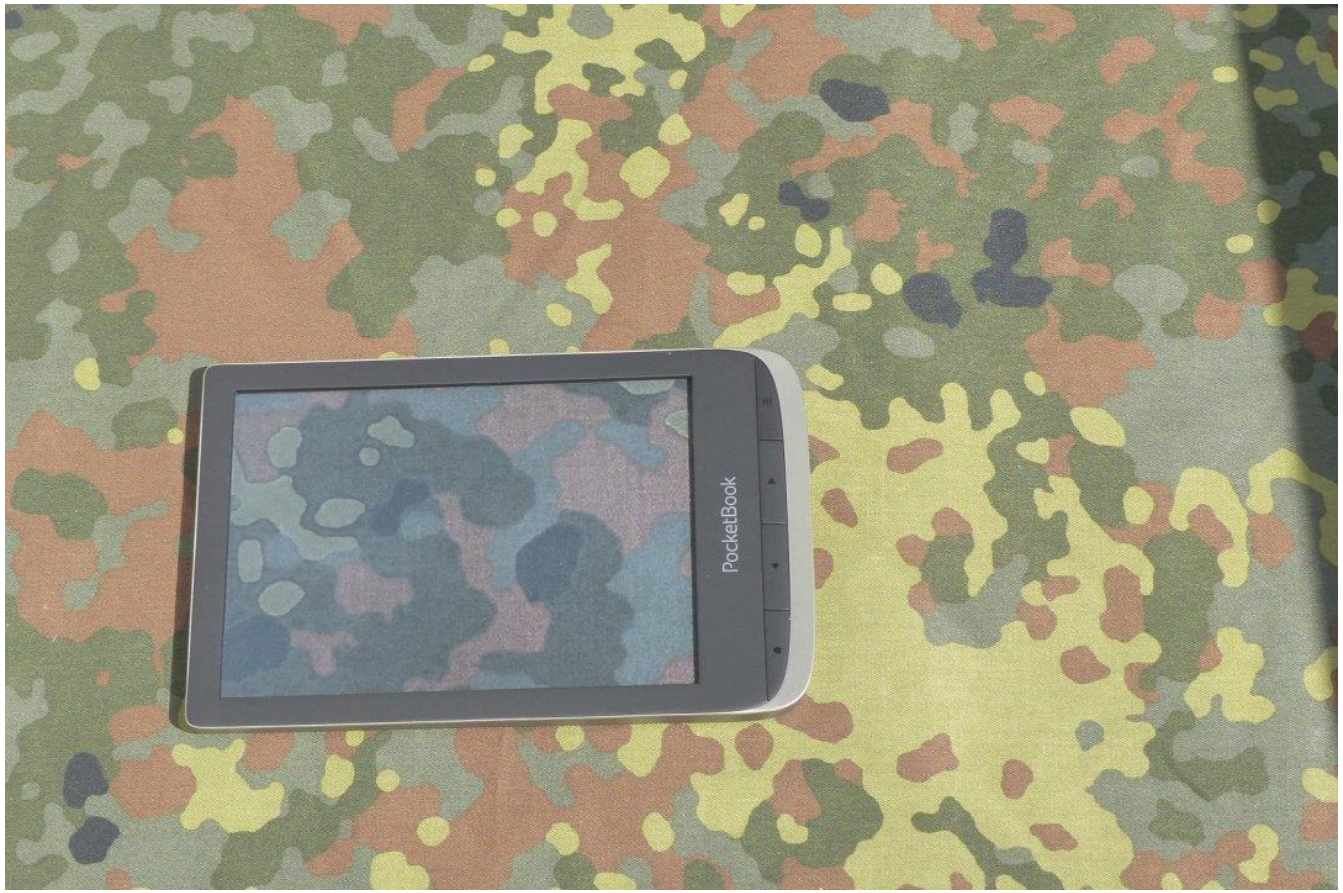


Passive flexible display from company Plastic Logic on plastic base

Passive display technologies



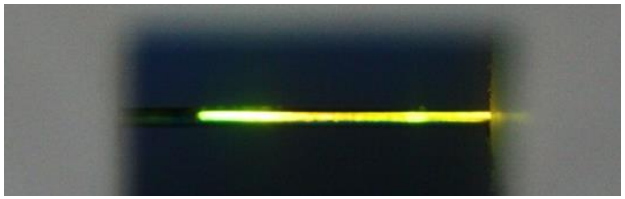
Passive display: E-Reader in direct sunlight

Active display technologies

Active display technologies

OLED on glas carrier within signal jacket [Janietz 2016]

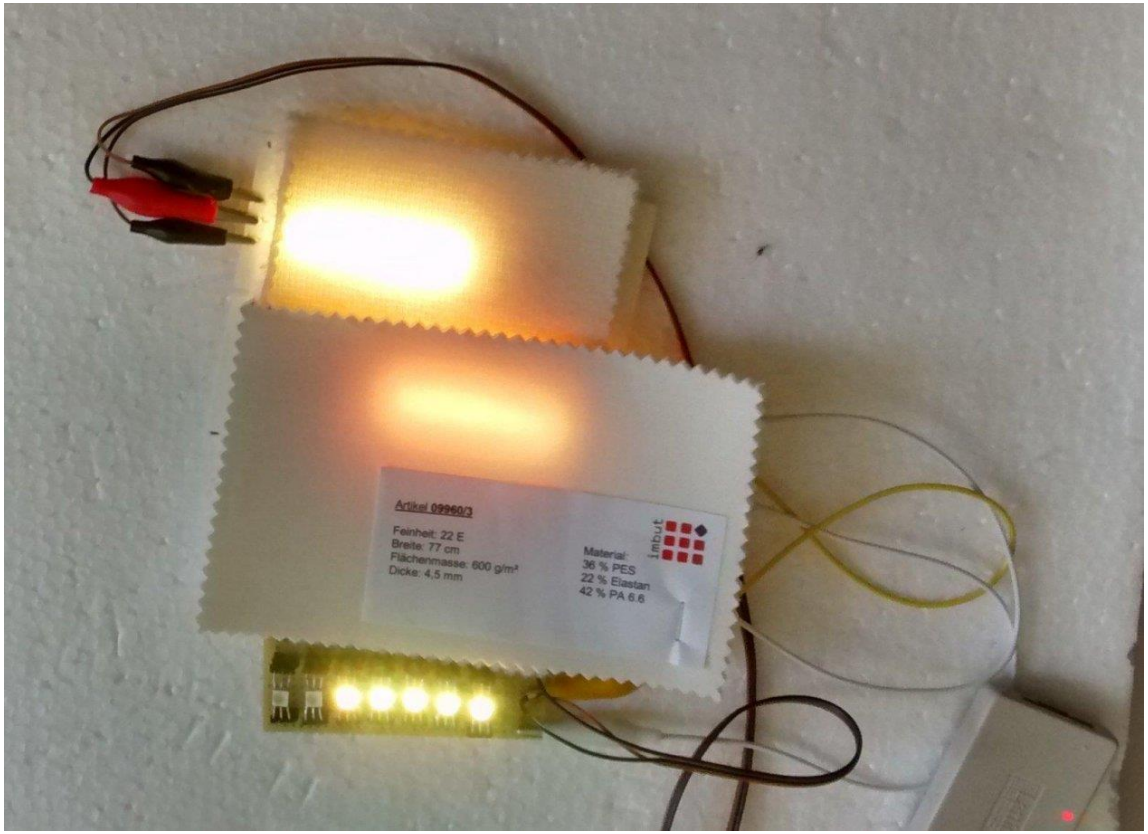
Flexible OLED-strip woven into Elitex yarn [Janietz 2016]



First OLED application on glas fibre substrate, lumilescent area approx. 5 mm^2 [Janietz 2016]

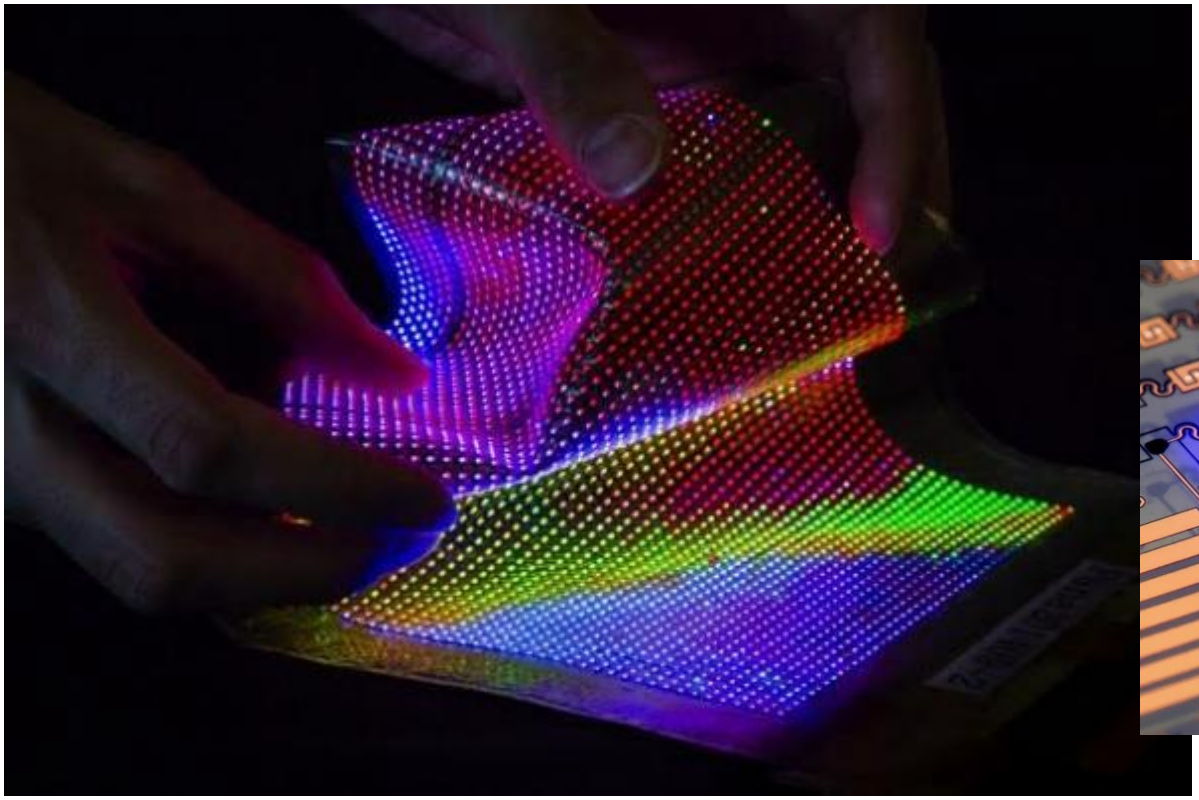
OLED technology developed by Fraunhofer IAP

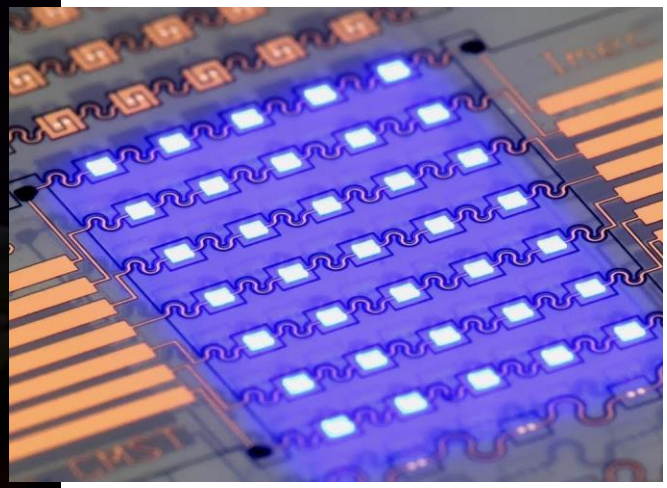
Active display technologies



LED-Study with diffusor fabric, TITV Greiz

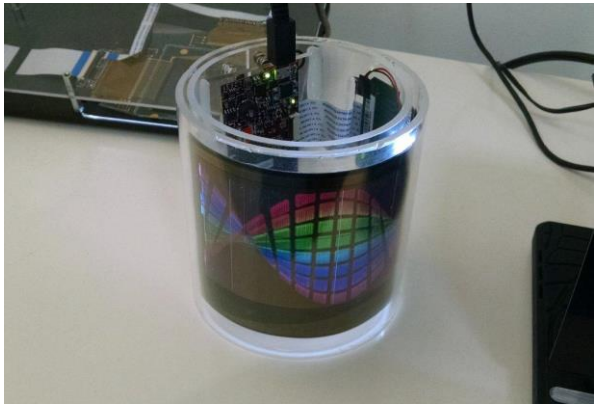
Active display technologies

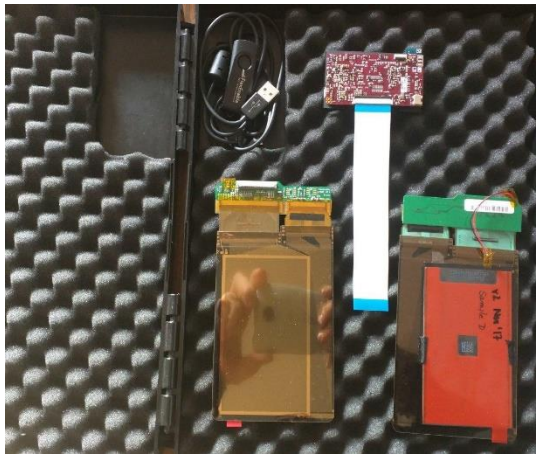


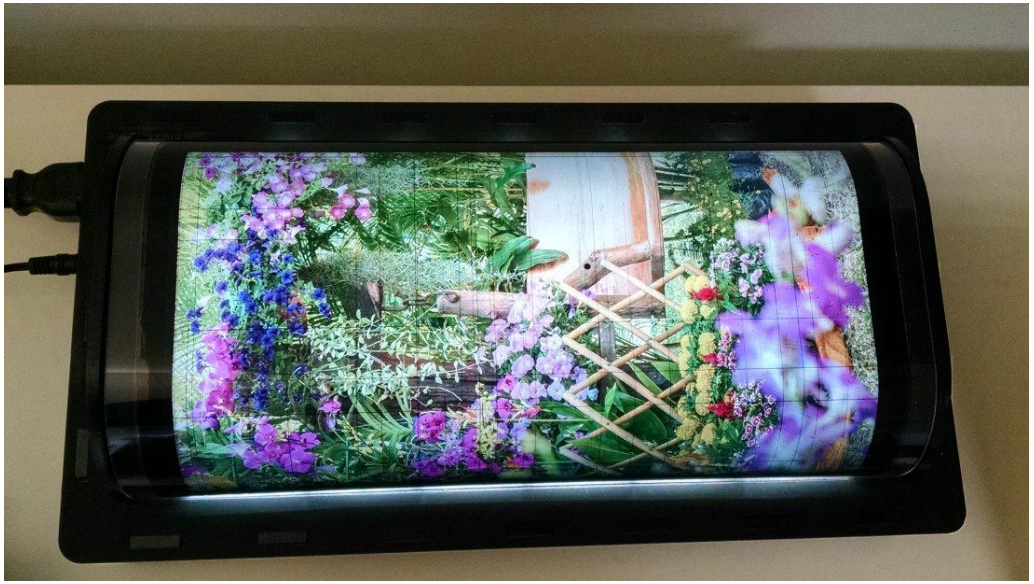


LEDs on polyamide-carrier (Nylon)
Spacing of LEDs 1 mm, © Holst Center [Happich 2015]

Active display technologies







OLCD company FlexEnable Cambridge 4,7“ / 12,1“

Active display technologies

OLED display, company LG 55“ / 65“

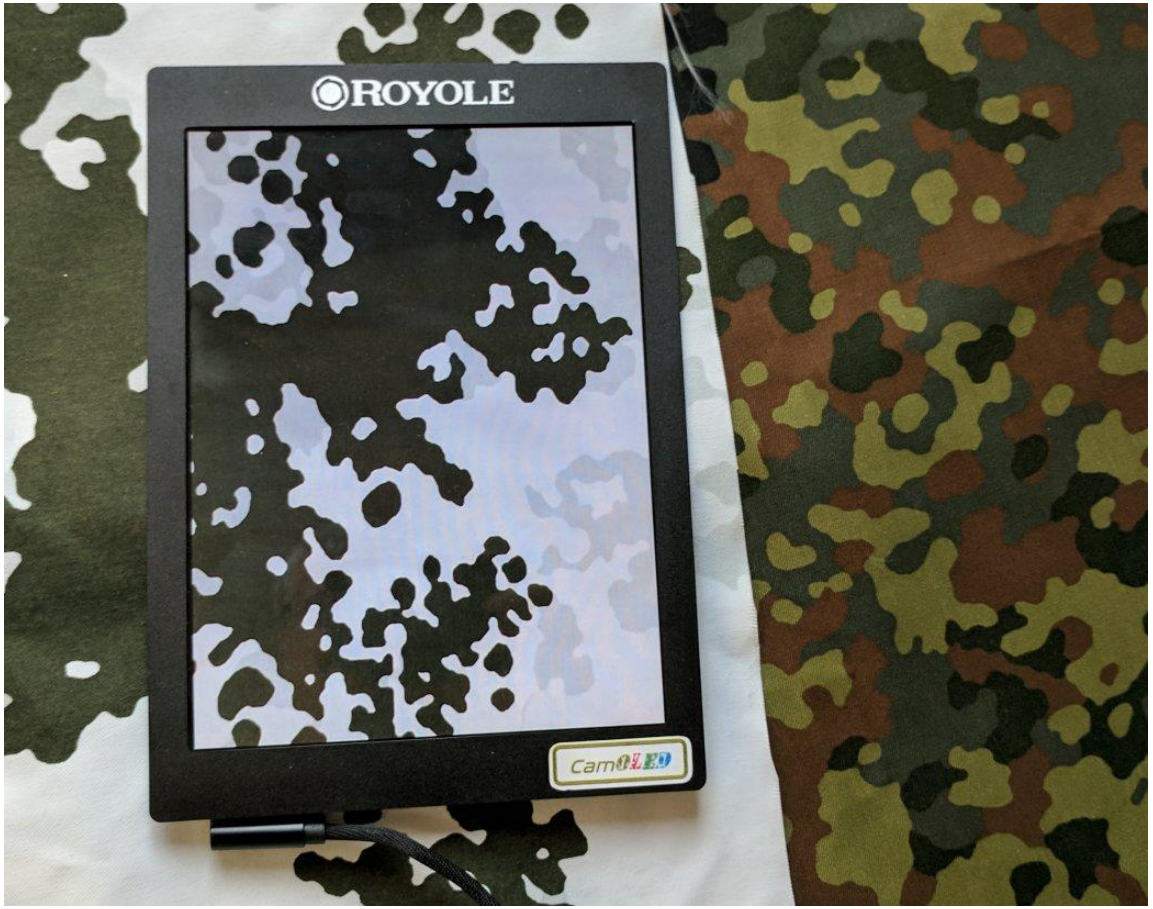
Active display technologies

OLED display, company LG 55“ / 65“

Active display technologies

OLED display, company LG 55“ / 65“

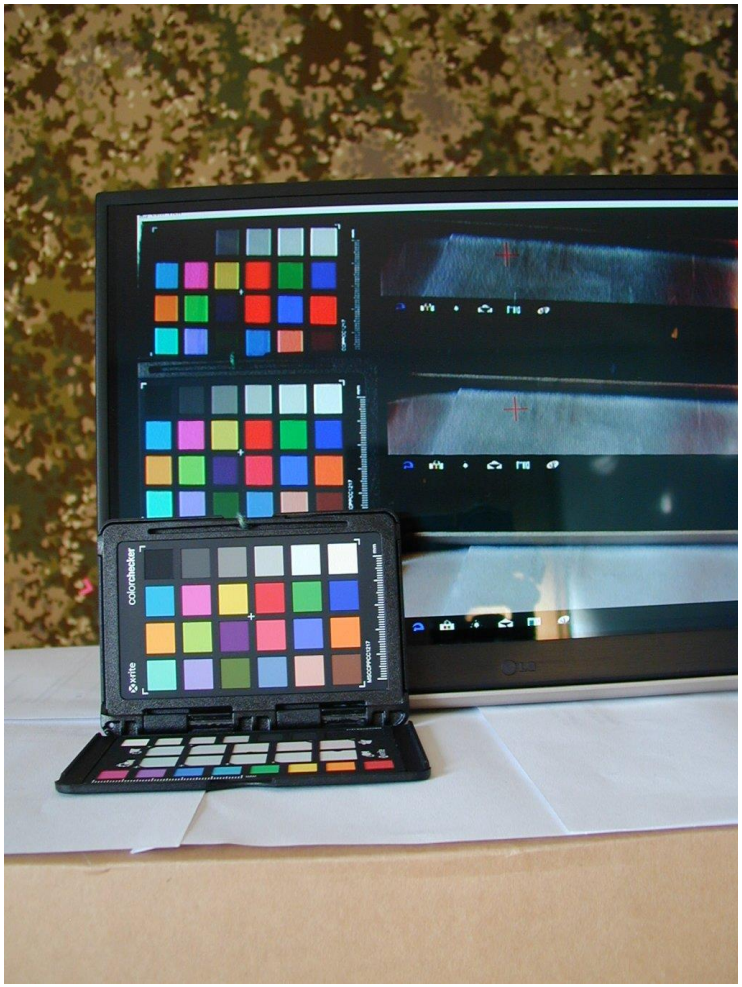
Active display technologies



Flexible OLED display, company Royole, 140 x 190 mm^2

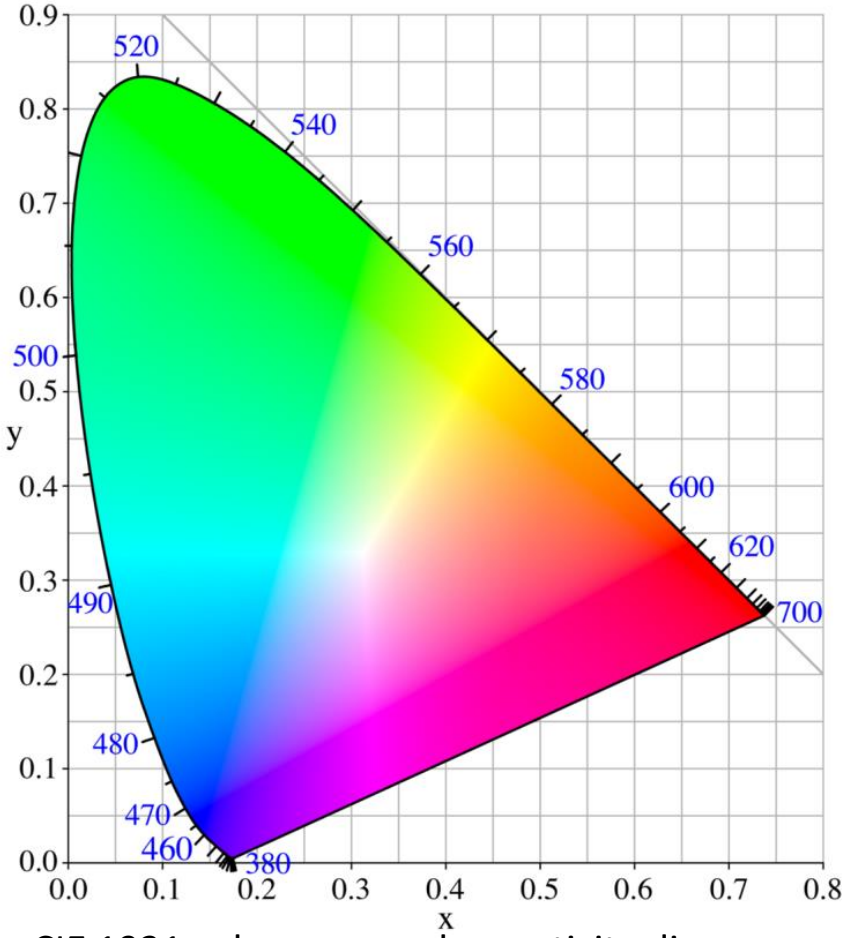
Algorithms

Algorithms: Colour / Brightness

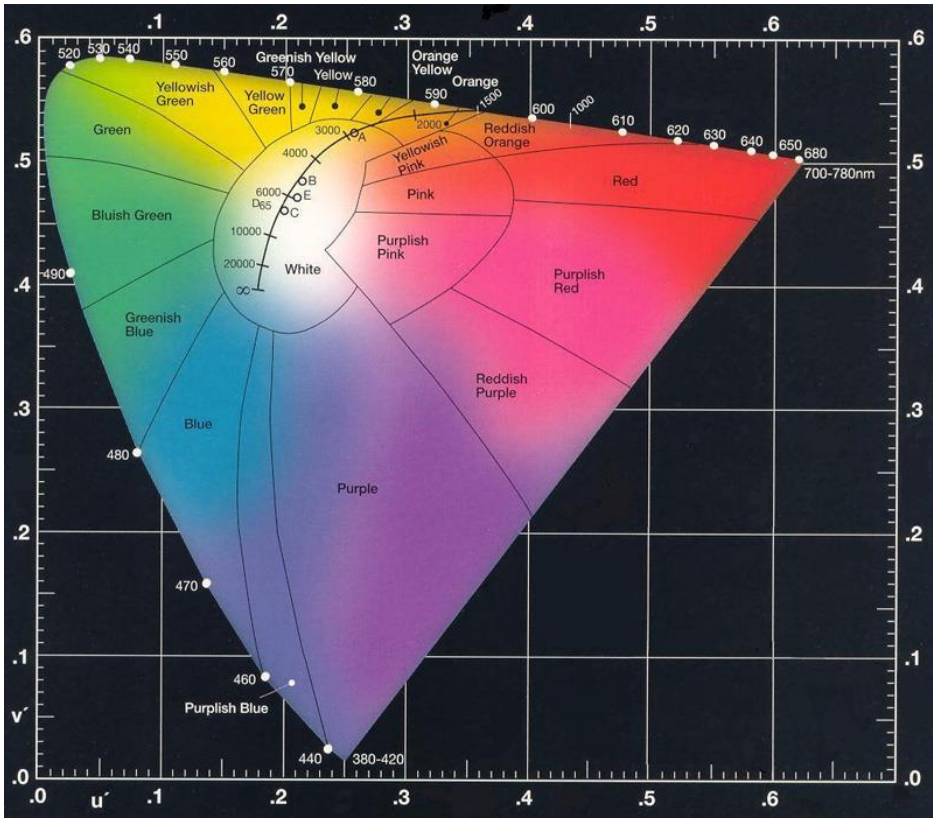


Colour matching by colour reference chart

Algorithms: Colour / Brightness

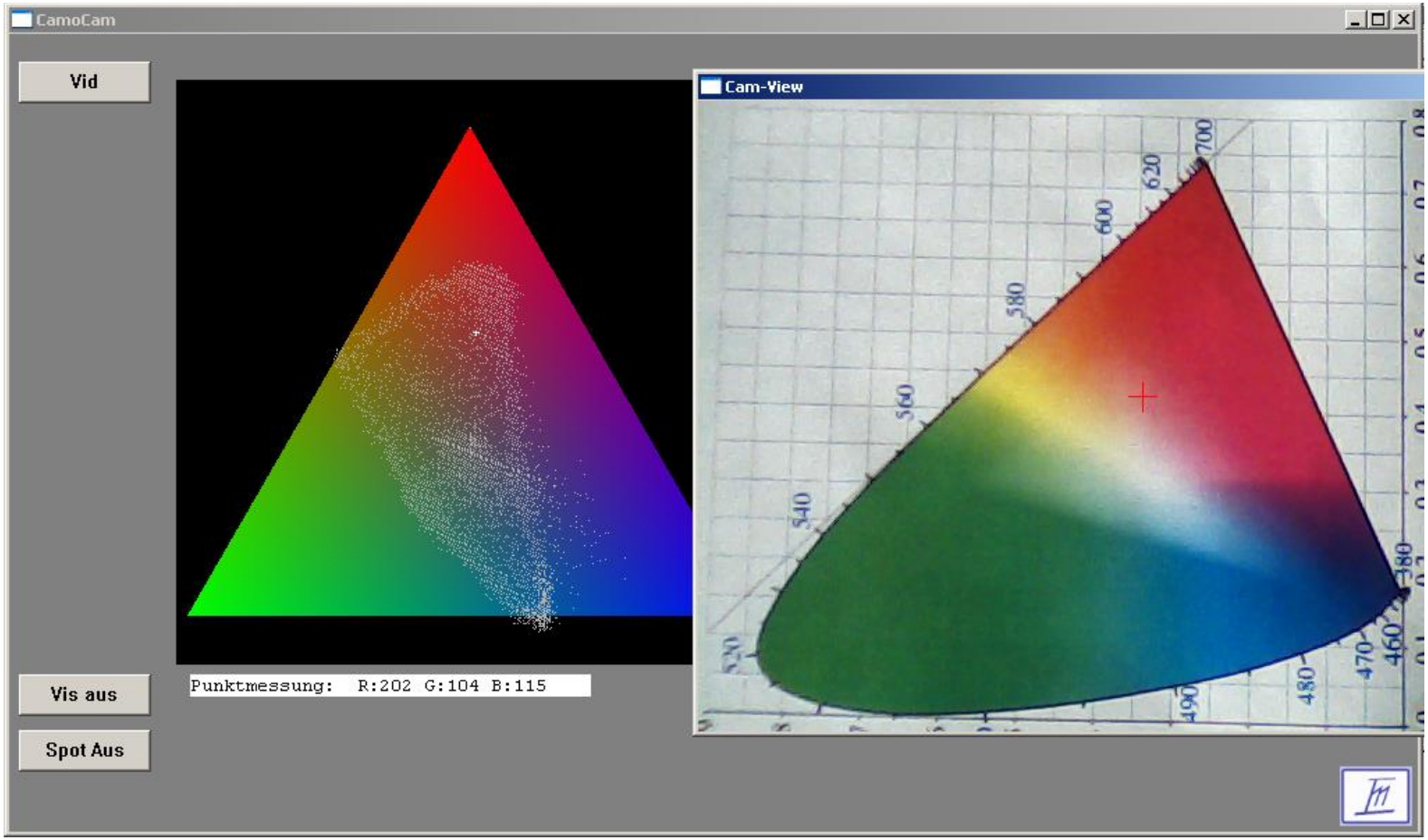


CIE 1931 colour space chromaticity diagram



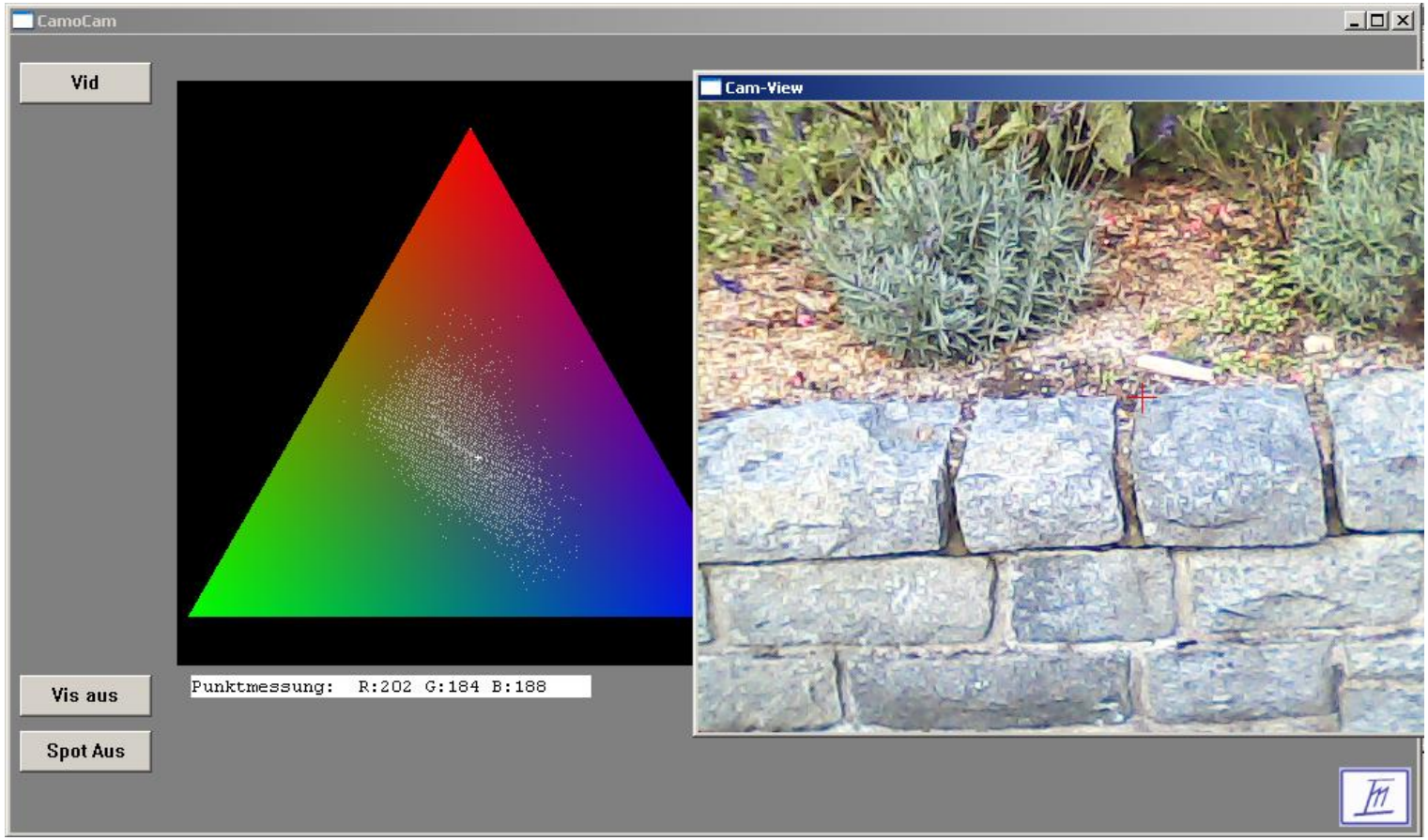
CIE-LUV colour space from 1976

Algorithms: Colour / Brightness



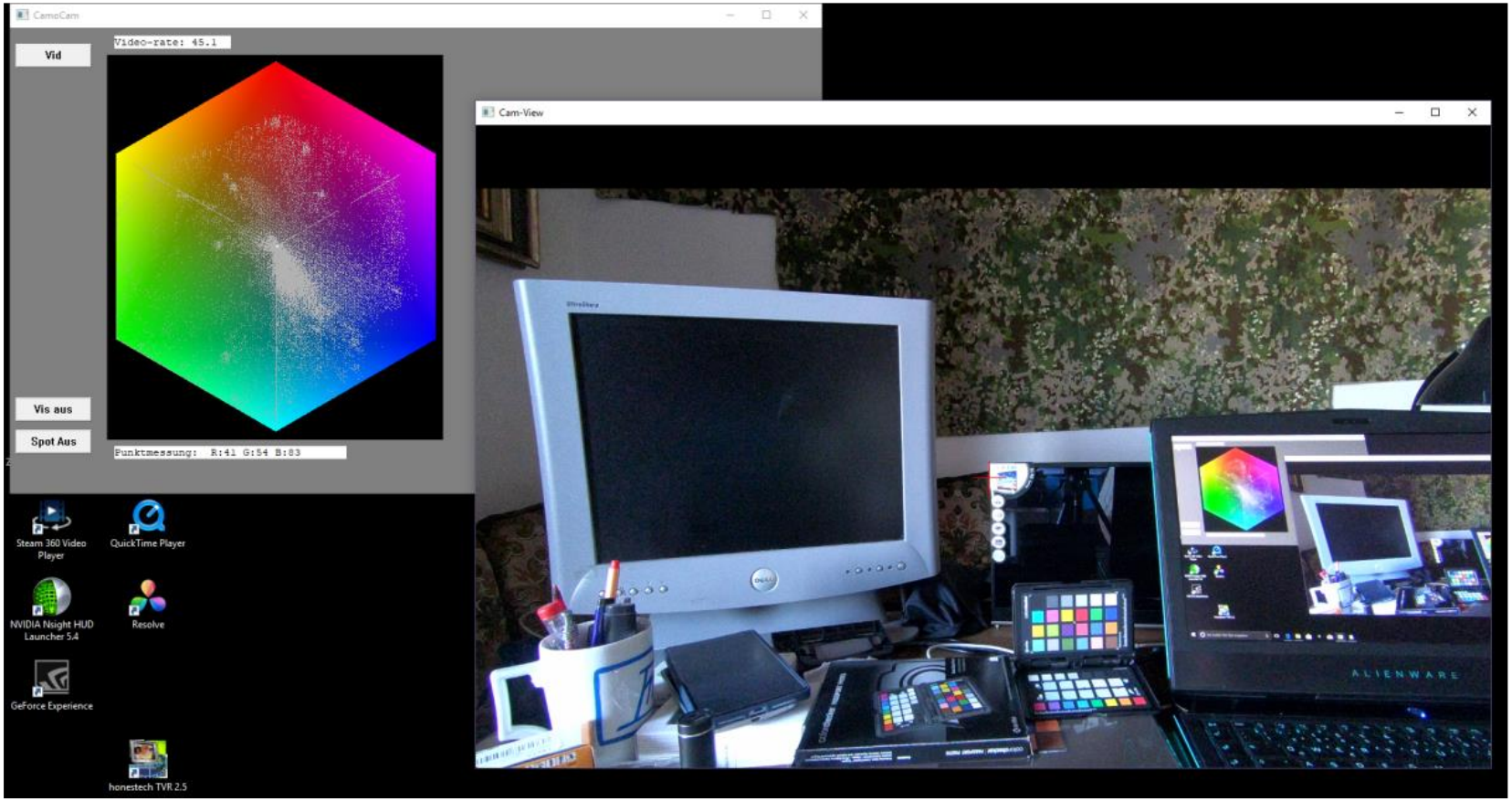
Colorimetry with digital camera

Algorithms: Colour / Brightness



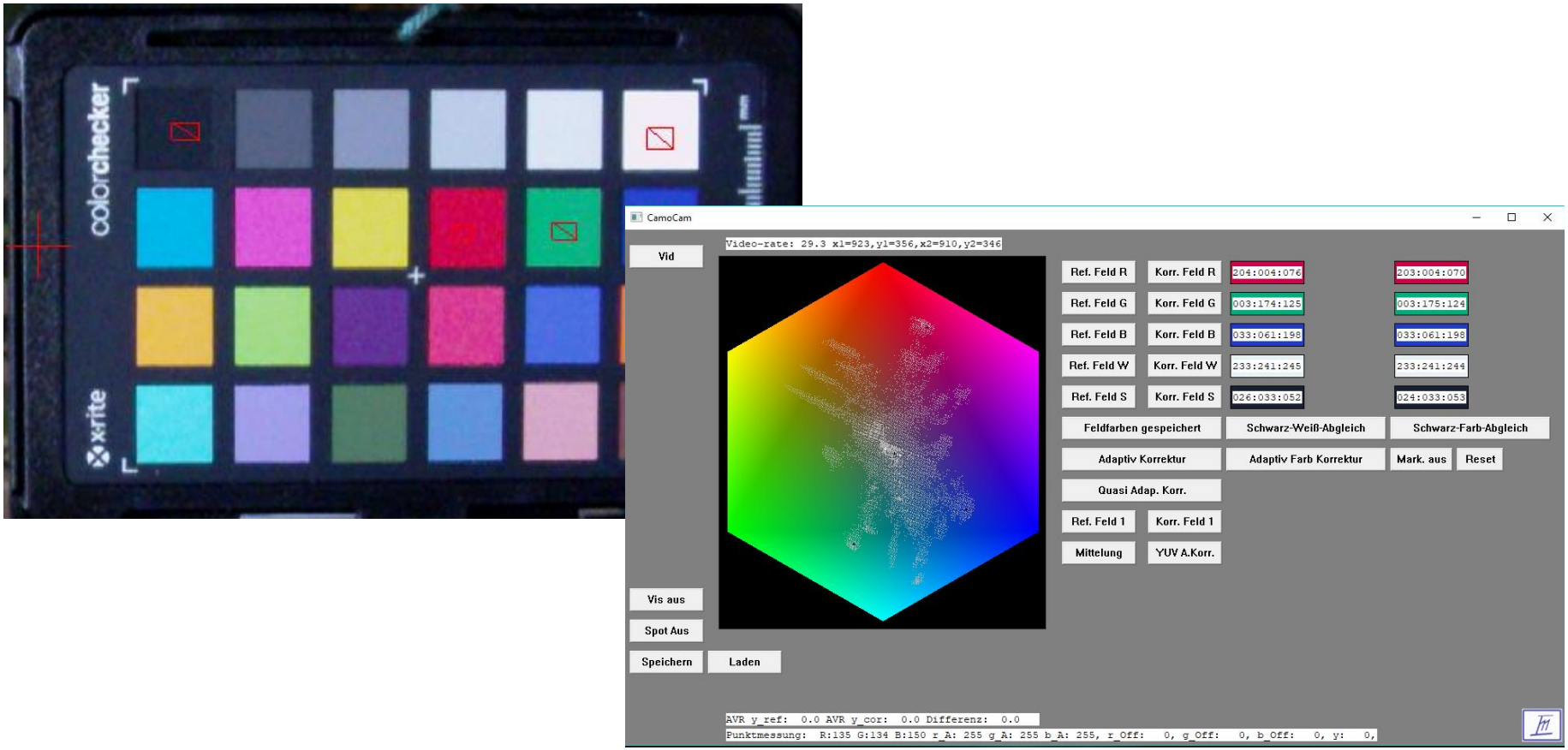
Colorimetry with digital camera, granite with vegetation

Algorithms: Colour / Brightness



Colorimetry with digital camera, rgb colour space, colour reference chart

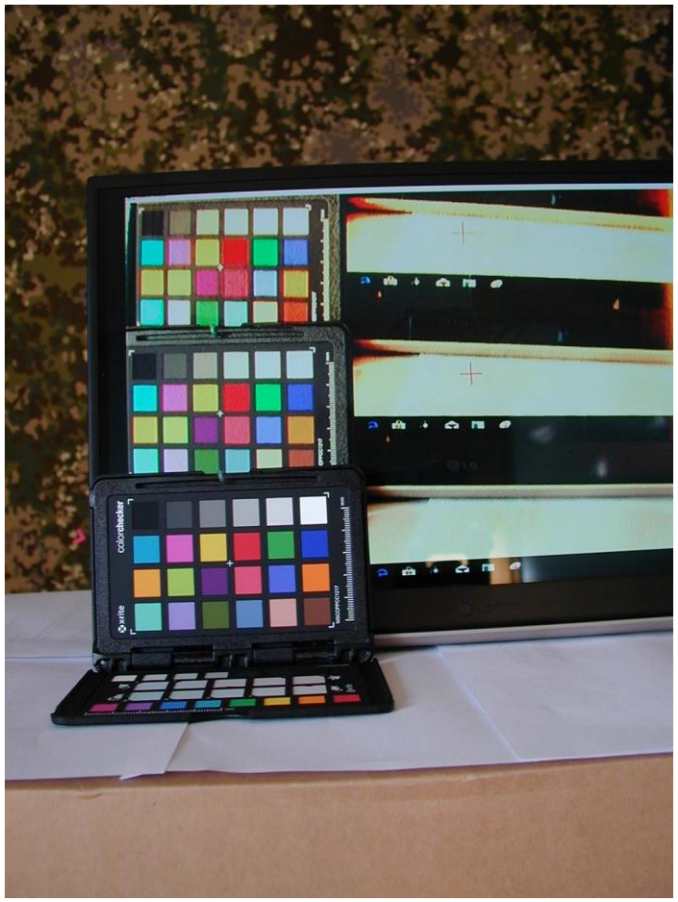
Algorithms: Colour / Brightness



Colour matching by colour reference chart

Algorithms: Colour / Brightness

Colour matching by colour reference chart



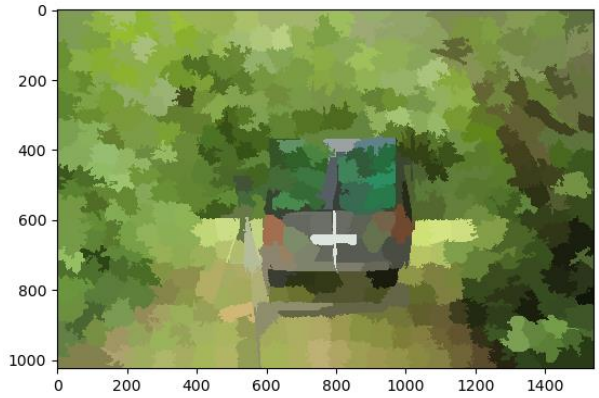
Colour reference chart in 0th, 1st and 2nd order after colour matching

Algorithms: Colour / Brightness

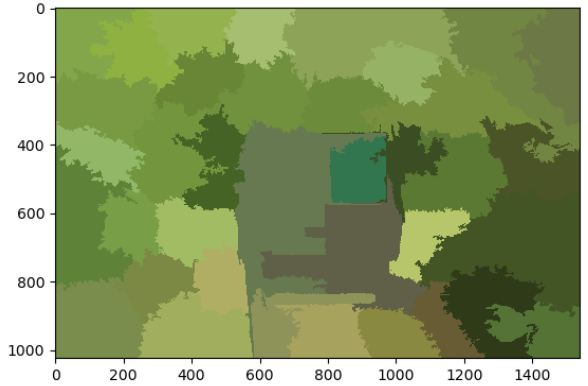
Colour matching without colour reference chart

Algorithms: Adaptive camouflage patterns

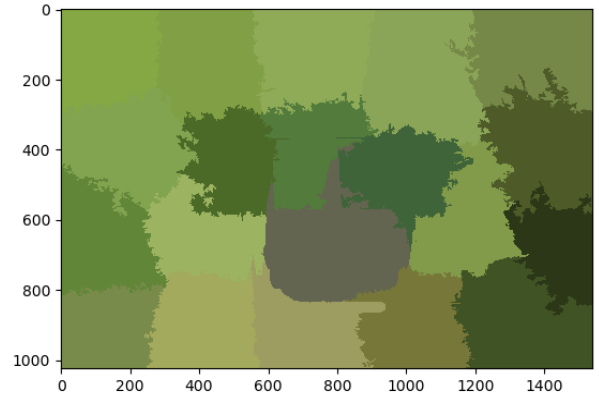
Algorithms: Adaptive camouflage patterns



S=500



S=50



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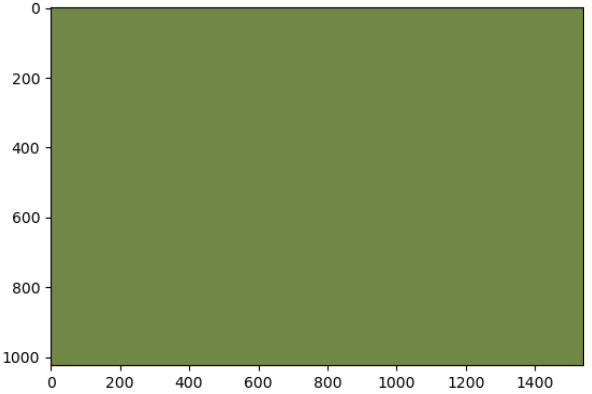
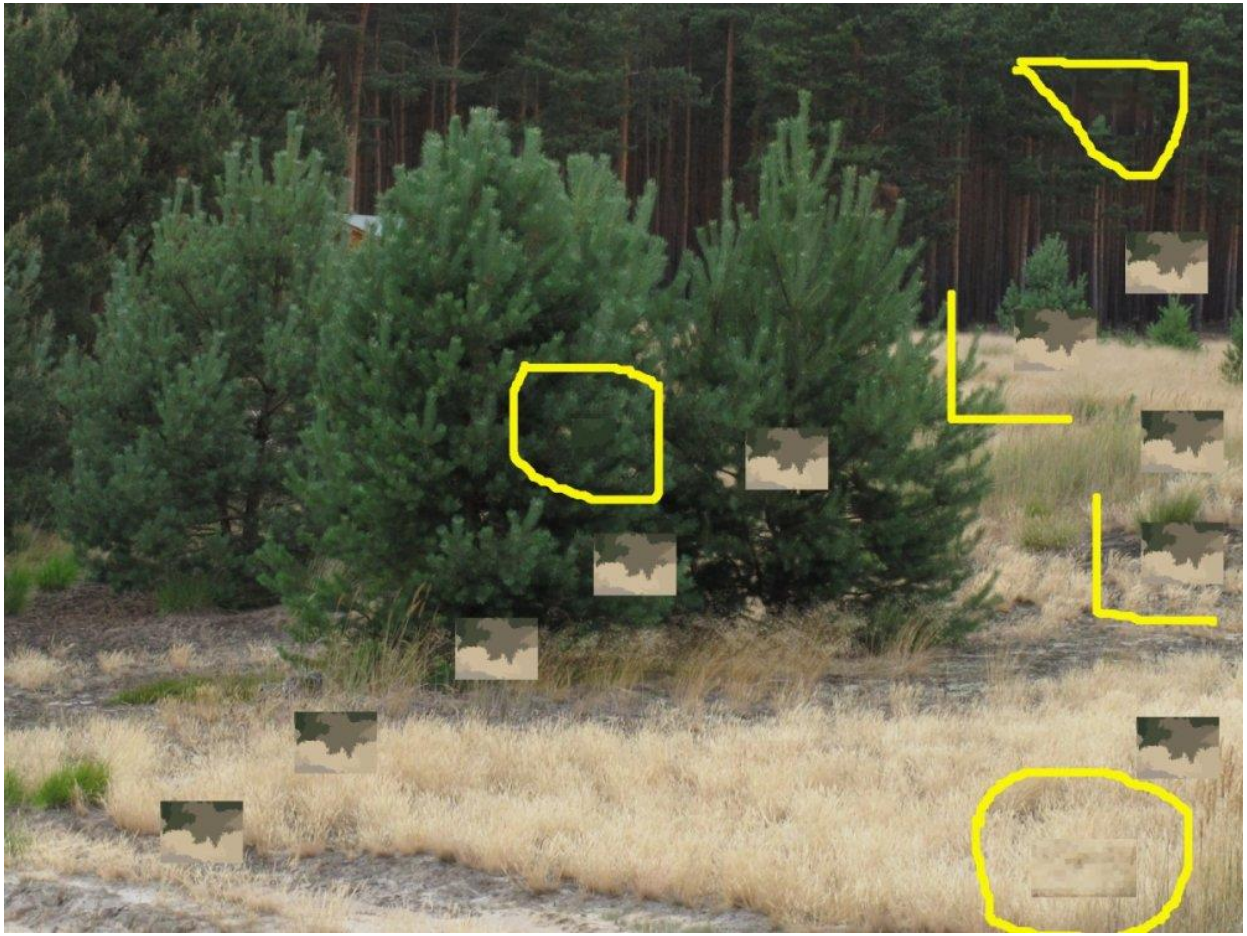


S=5

SLIC Algorithm

Algorithms: Adaptive camouflage patterns



Scenario Storkow 01

Algorithms: Adaptive camouflage patterns

Scenario Storkow 04

Algorithms: Adaptive camouflage patterns

Scenario Pangsy 12

Investigation under daylight conditions

Investigation under daylight conditions

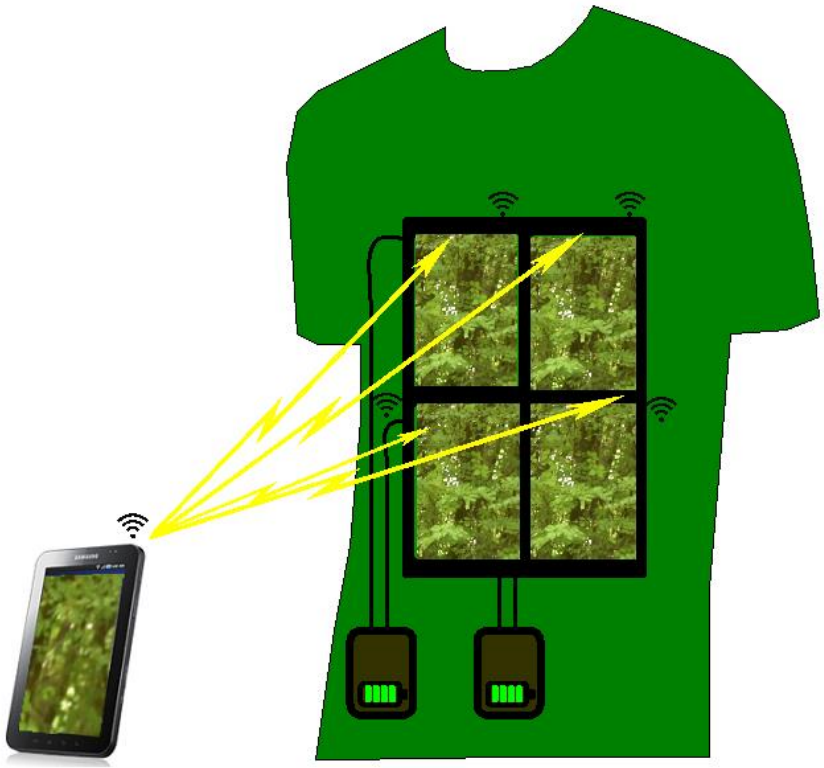
OLED Display, Company LG 55“, 500 cd/m^2

Investigation Under daylight conditions

OLED Display LG 65“, Configuration for colour matching

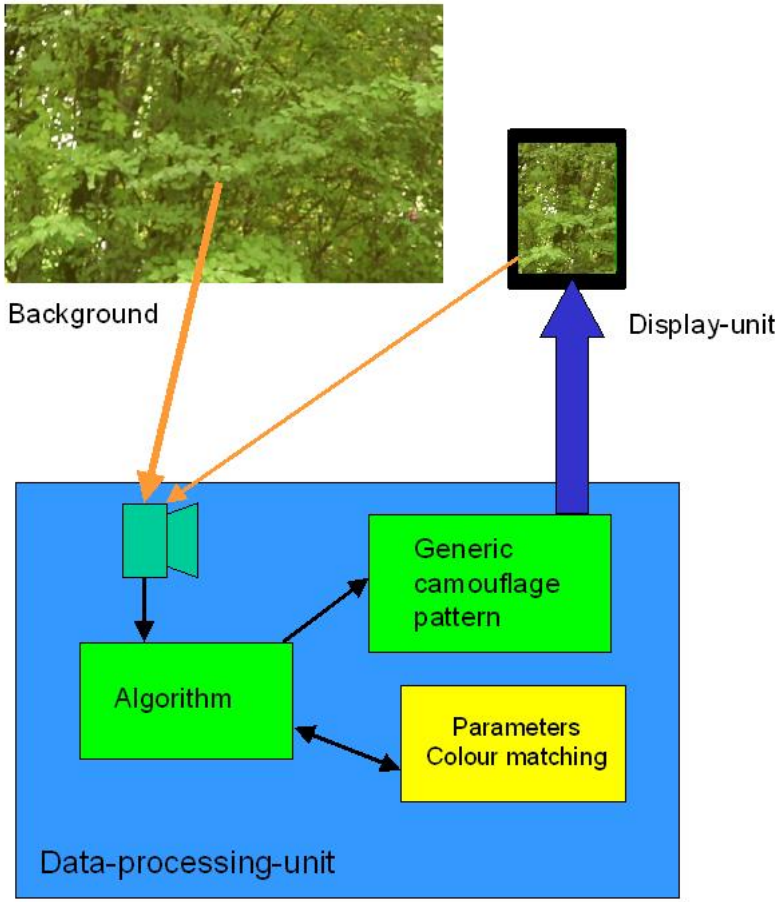
Demonstrator with flexible OLED displays

Demonstrator with flexible OLED displays



Conceptual design of the demonstrator for active optical camouflage

Demonstrator with flexible OLED displays



Dataflow for active optical camouflage

Demonstrator with flexible OLED displays

Test: 4-display-configuration with natural background

Demonstrator with flexible OLED displays

Prototype OLED-Shirt with 6 displays

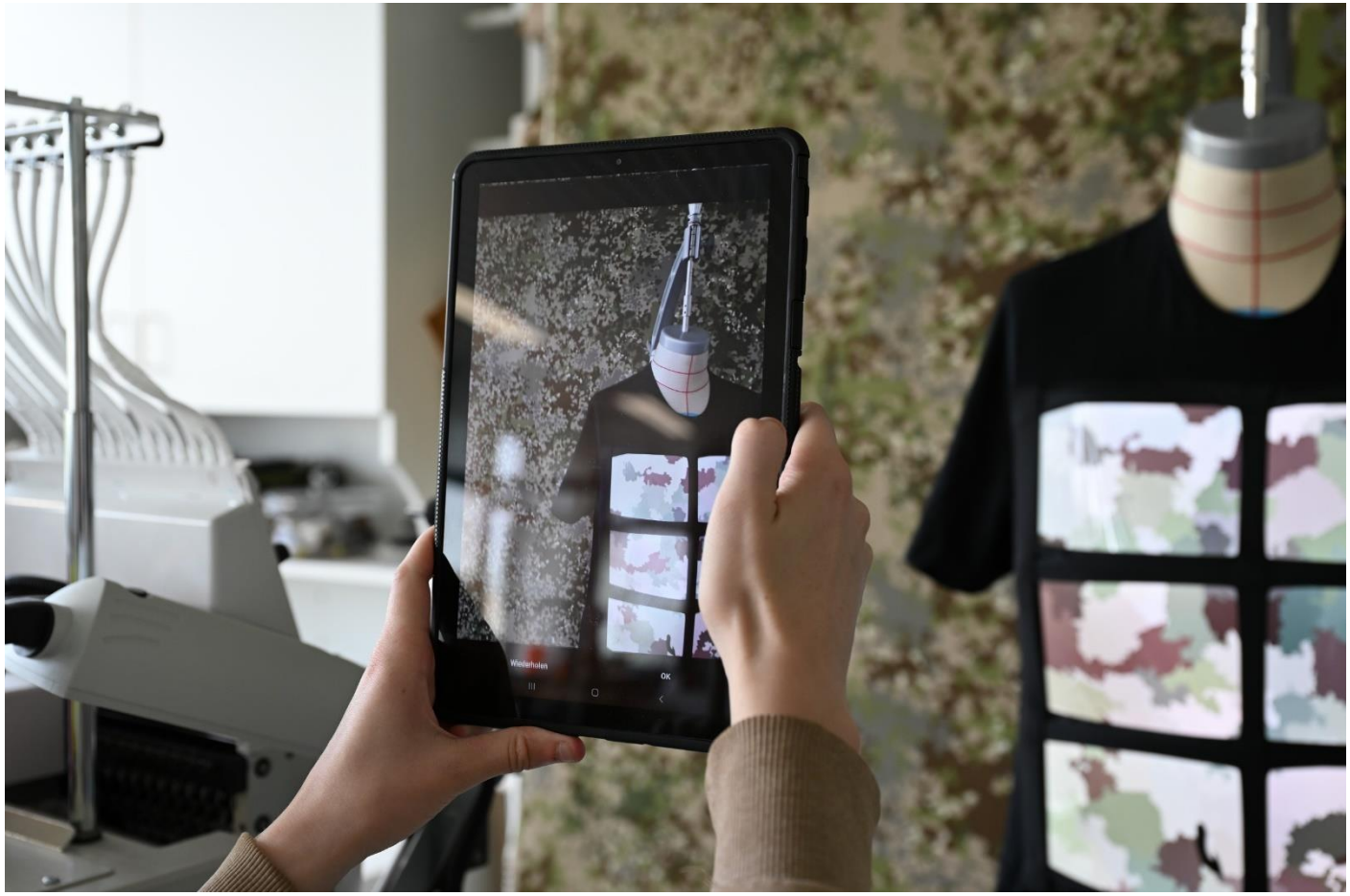
Demonstrator: Operation

Capture of background

Demonstrator: Operation

Processing / Pattern generation

Demonstrator: Operation



Transmission to display-array

Demonstrator: Operation

Vegetation / woodland background

Demonstrator: Operation

Urban background

Elimination of movement

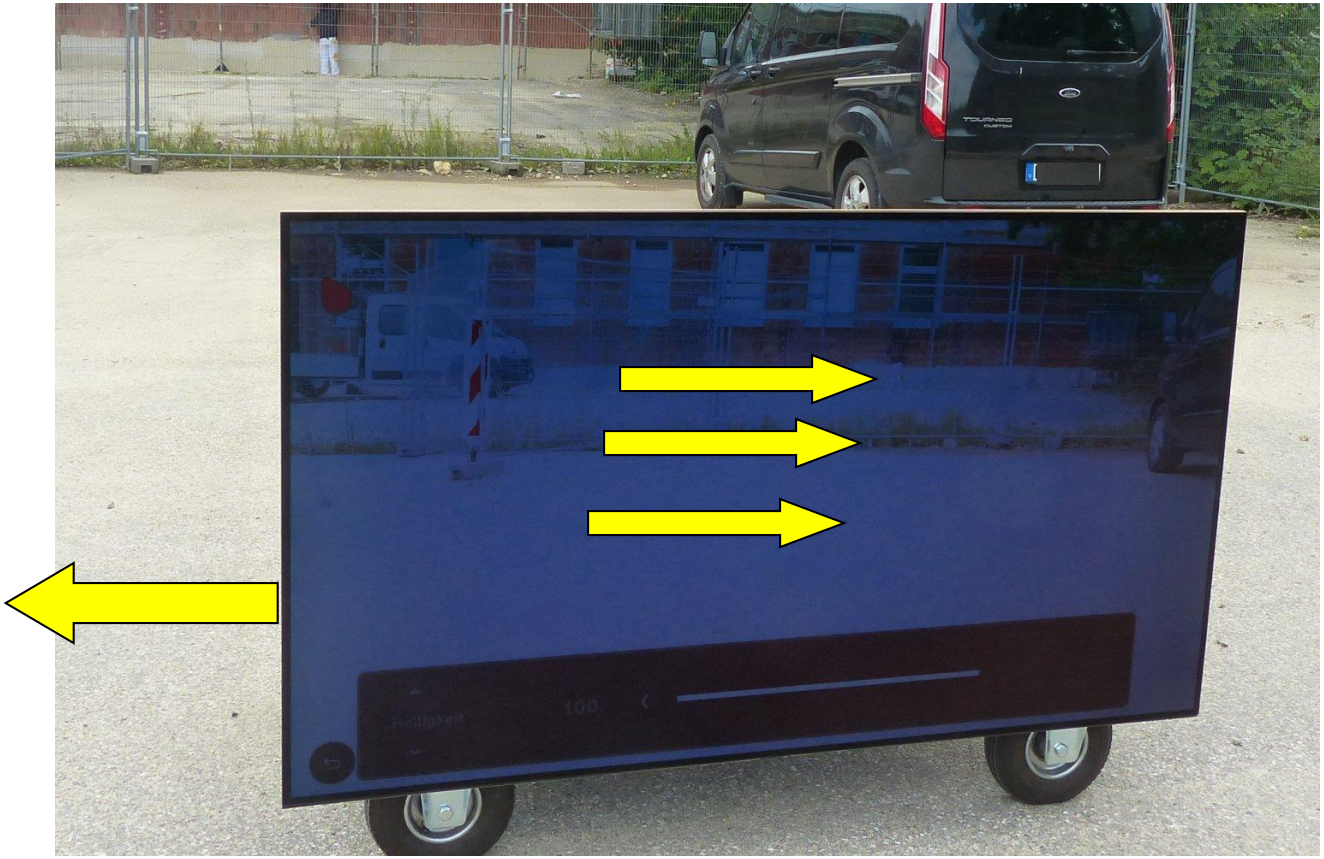
Elimination of movement

Test setup

Elimination of movement

Test setup

Elimination of movement: Principle



Test setup

Elimination of movement: Principle

Elimination of movement: Principle

Elimination of movement: Principle

Elimination of movement: Principle

Elimination of movement: Video

Your Contact

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Literature

[Happich 2015] Julien Happich, “Imec laminates stretchable LED display onto garments”, Smart2.0, http://www.smart2zero.com, 2. Sept. 2015

[Janietz 2016] S. Janietz, “Möglichkeiten der Integration von OLEDs, OPV und Batterien in Textilien", Wehrtechnisches Symposium*, “Die Zukunft der Bekleidung und persönlichen Ausrüstung in der Bw”***,** WIWeB Erding, 11. - 13. Oktober 2016

[Madritsch 2018] Madritsch, Franz, “Smarte Textilien zur adaptiven Tarnung mittels OLED-Technologie", *Abschlussbericht Studie E/E210/AH002/CF183 WIWeB*, AB-201801, 2018.

[Madritsch 2020] Madritsch, Franz, Madritsch Juliana “Smarte Textilien zur adaptiven Tarnung mittels OLED-Technologie", *Abschlussbericht Studie E/E210/AJ004/CF183 WIWeB*, AB-202003, 2020.

[Stutz2017] Stutz, David; Hermans, Alexander; Leibe, Bastian, “Superpixels: An Evaluation of the State-of-the-Art”, Visual Computing Institute, RWTH Aachen University, 19.04.2017, https://arxiv.org/pdf/1612.01601.pdf.