University of Novi Sad
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DEPARTMENT OF GRAPHIC
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ATHENS &
CORINTHIA
GREECE

The automated customization of SVG content for users with colour vision deficiencies

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CVD -colour vision deficiency

- approximately **8%** of the **male** and **0.5%** of the **female** population
- Based on severity of CVD there are:

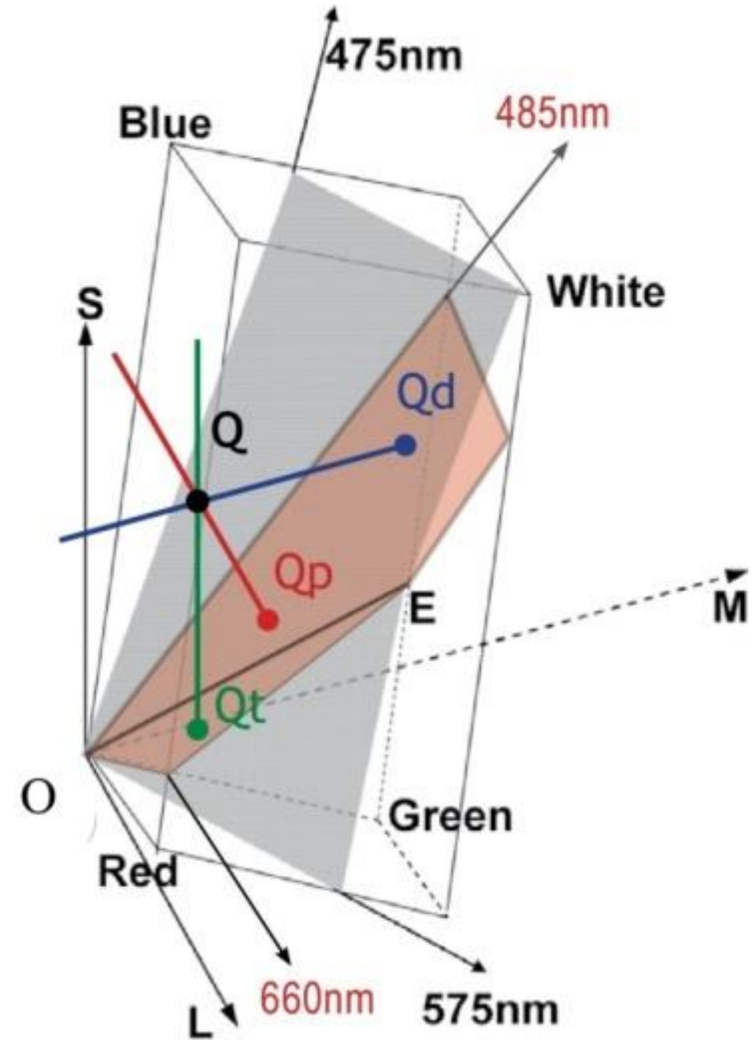
1. **monochromacy** – all or two cone types absent;
2. **dichromacy** -one of the cone types missing Protanopia/L, Deuteranopia /M, Tritanopia/S
3. **anomalous trichromacy**

Dichromatic colour gamut

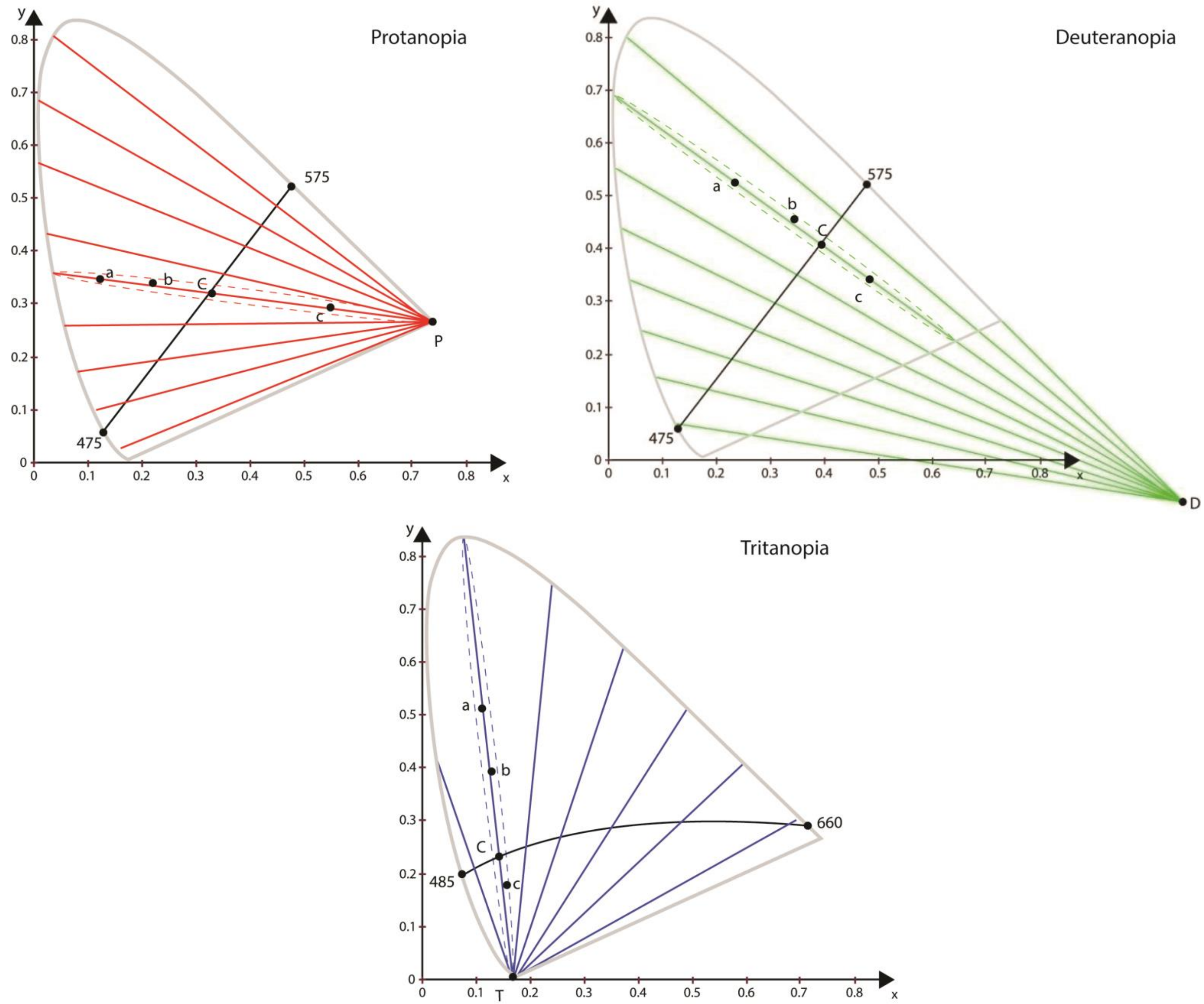
- Brettel and Vienot

Invariant stimuli
(perceived as the same as
normal vision observer):

- P, D: 475nm and 575nm
- T: 485nm and 660nm



Problem with the colour?



Daltonization

1. Pixel-based algorithms with adaptation based on increasing contrast ("stretching" histogram) or transformation of colour coordinates (hue rotations)
2. Complex re-mapping methods where the colour gamut of the initial image is mapped to the new one without confusing colour combinations

Example: Pixel-based algorithm

original image

simulated dichromatic version

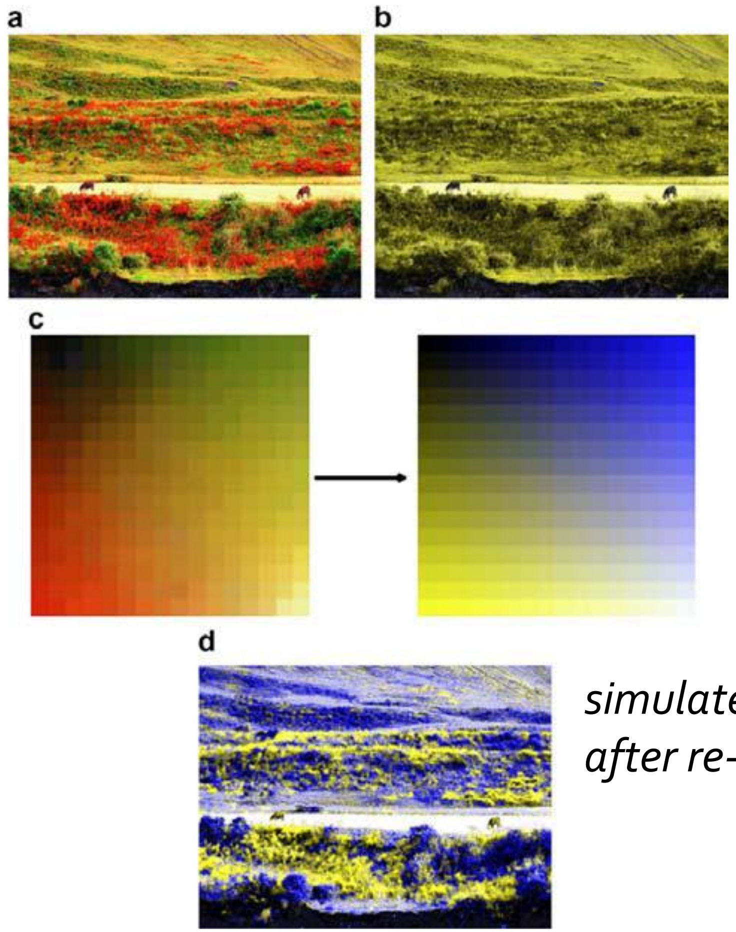
image after re-colouring

simulated image after re-colouring

Example: Non pixel-based alogorithm

original image

simulated dichromatic version



simulated image after re-colouring

What is SVG and why is it popular?

- scalability and resolution independence
- faster download times
- editing ability
- support for animation
- dynamic creation of content

What is SVG and why is it popular?

```
<svg>
<rect x="6.696" y="6.69 … F5EA2" stroke-
    width="13" stroke-m … .067"
    height="270.067"/>
<g>
<text transform="matri … font-
    family="'MyriadPro- … 014</text>
<rect x="30.5" y="153.5 … .2" height="12"/>
<rect x="46" y="153.5" … " height="12"/>
…
<rect x="77" y="201.5" fill="#2FACE2" width="12" height="12"/>
</g>
</svg>
```

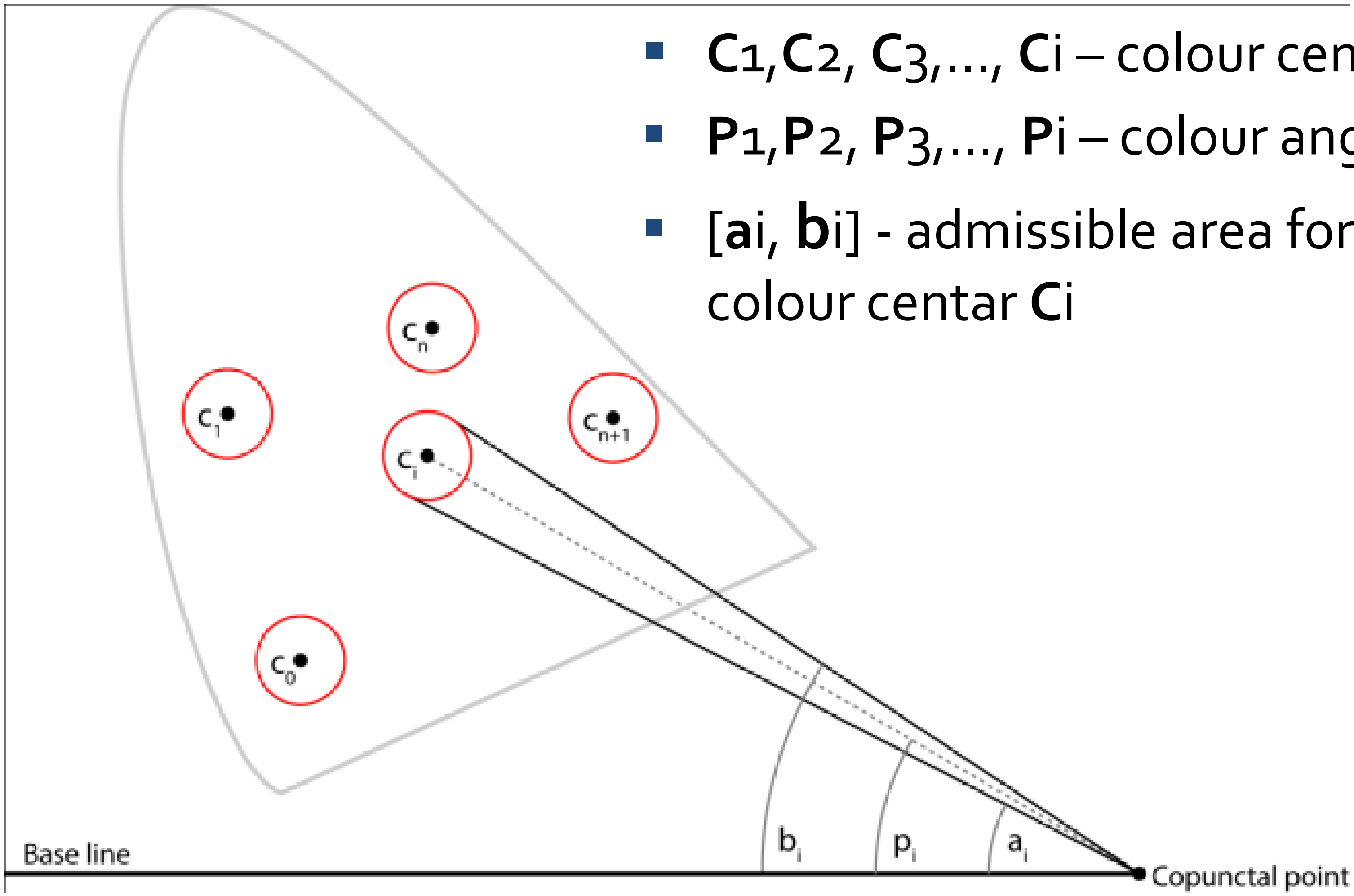
SVG and JavaScript

- Colour values in SVG may be specified the same way they are in HTML/CSS
- For example, green colour can be defined as "green", "#0f0", "#00ff00", "rgb(0,255,0)", or as "rgb(0%,100%,0%)".
- If O is a variable referring to an SVG object
  O.getAttribute("fill") for extracting colour information
  O.setAttribute("fill",colour_value) for applying different colour

The concept of proposed colour adaptation

1. gathering colour information from SVG objects
2. grouping elements with the same colour
3. transforming RGB/hexadecimal to xyz values
4. calculation of input parameters for remapping
5. remapping of colours
6. transforming new xyz values back to RGB and applying them to SVG objects

The re-mapping algorithm



- **C**1,**C**2, **C**3,..., **C**i – colour centars
- **P**1,**P**2, **P**3,..., **P**i – colour angles
- [**a**i, **b**i] - admissible area for any colour centar **C**i

The re-mapping algorithm

- The goal is to find the new angles p_i in a way that they are distributed in a most possibly even way:
- if $a_i < ½\,(p_{i-1}+p_{i+1}) < b_i$, then $p_i = ½\,(p_{i-1}+p_{i+1})$
- if $½\,(p_{i-1}+p_{i+1}) \leq a_i$, then $p_i = a_i$
- if $b_i \leq ½\,(p_{i-1}+p_{i+1})$, then $p_i = b_i$
- where $p_o, p_1, . . . , p_n , p_{n+1}$ are positive real numbers in ascending order $(p_1 < p_2 <\cdot\cdot\cdot < p_n)$.

Results: SVG map of metro original map

Citations
Athens Public Transportation Map (Athens: OASA, 2013)

Results: SVG map of metro protanopic simulation

Athens Public Transportation Map (Athens: OASA, 2013)

Results: SVG map of metro Chrome Daltonize adaptation

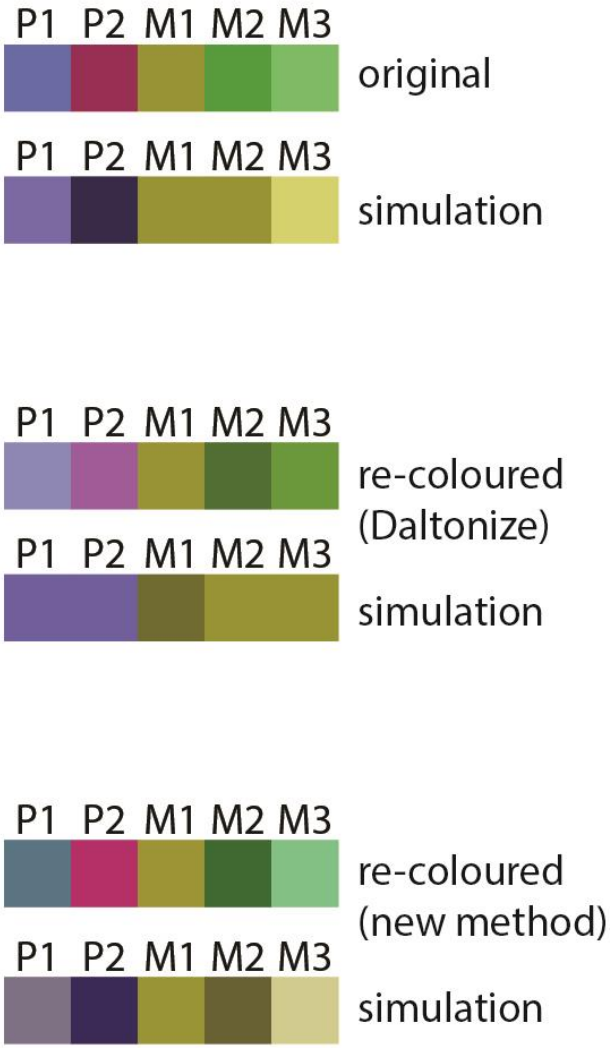
Results: SVG map of metro protanopic simulation of adaptation

Results: SVG map of metro proposed adaptation

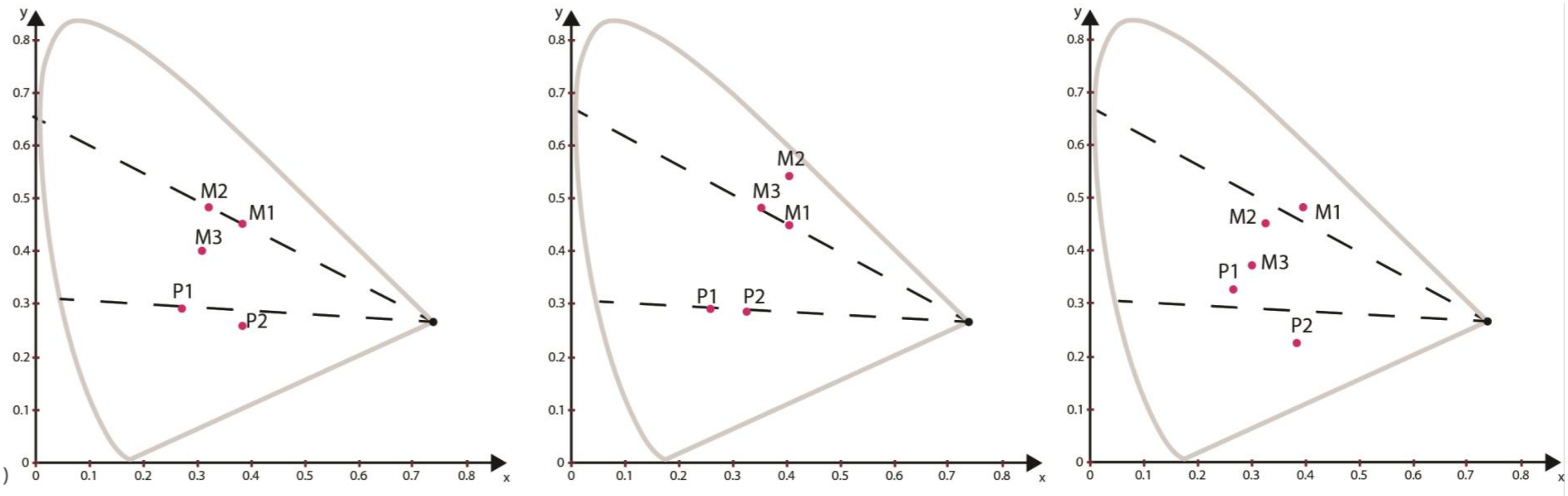
Citation:
Athens Public Transportation Map (Athens: OASA, 2013)
<http://stasy.gr/fileadmin/pages_material/metakinitheite/maps/Diktyo_Astikon_Sygkinonion_Athinon_en.pdf>
(Accessed 28 December 2013)

Results: SVG map of metro protanopic simulation of adaptation

Colour scheme



Simulation of colour gammuts



original

re-coloured (Daltonize)

re-coloured (new method)

Conclusion

- Increasing number of distinguishing details
- Computationally efficient

Thank you for the atention

- …and we are inviting you to our conference in Novi Sad, Serbia, November 2014…
- www.grid.uns.ac.rs/symposium

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