A color transformation for robust detection of color landmarks in robotic contexts

R. Moreno, M. Graña, A.d'Anjou

[1]Computational Intelligence Group
Basque Country University

PAAMs 2010

Outline

Introduction

- We present in this work a robust color transformation which has been applied succesfully to natural scenes allowing the fast and precise segmentation of regions corresponding to color landmarks under uncontrolled lightning.
- The process is grounded in the the Dichromatic Reflexion Model (DRM) and the properties of the RGB space.

RGB Space

- The need to detect color regions steems from its conventional use in signaling: red for danger, blue and green for informative, yelow for danger advice. Also Red, Green and Blue are the basic colors in the RGB space unit cube

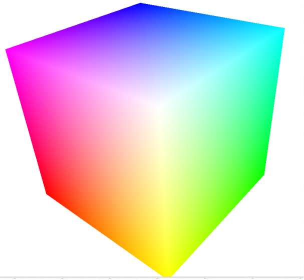


Figure: RGB cube

Dichromatic Reflection Model

We can classify image pixels into:

- **Diffuse pixels**: showing the observed surface color, with an almost null specular component.
- **Specular pixels**: whose specular component is much bigger than the diffuse component.

Algebraically, DRM is expressed as

$$I(x) = m_d(x)D + m_s(x)S$$

where m_d and m_s are weighting values for the diffuse and specular components, respectively

Dichromatic Reflection Model

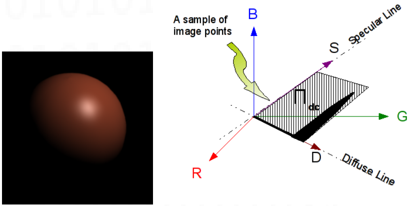
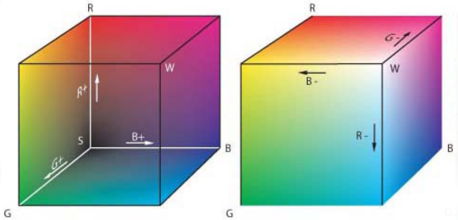


Figure: DRM, an example

DRM behavior on RGB Space



$L_w : (r, g, b) = P + s\overrightarrow{u}; \forall s \in \mathbb{R}$ where $P = [0, 0, 0]$ and $\overrightarrow{u} = [1, 1, 1]$
A main feature of line L_w is that the three components of its points are equal $r = g = b; \forall r, g, b \in [0, 1]$. For pixels close to this region, we have $r \simeq g \simeq b; \forall r, g, b \in [0, 1]$

Outline

Idea

The new intensity of the pixels is computed as difference between the maximum and minimum of their RGB components:

$$Intensity = \max_{\{r,g,b\}}(I) - \min_{\{r,g,b\}}(I)$$

Outline

Code

```
// I is a image in RGB
// IR is the transformed image
function IR = SF2(I)
 New_Intensity = (max(I,3)-min(I,3));
 Imghsv = rgb2hsv(I);
 Imghsv(:,:,3) = New_Intensity;
 IR = hsv2rgb(Imghsv);
endfunction
```

Outline

Synthetic Images I

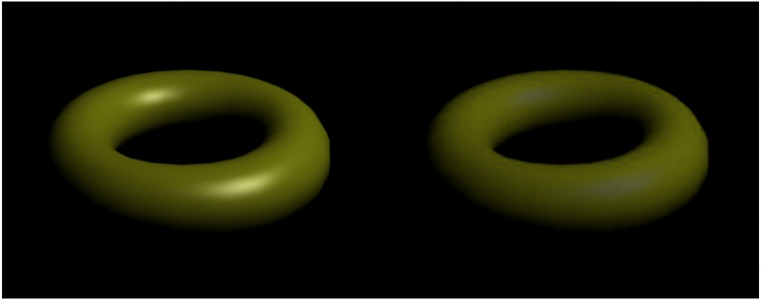


Figure: synthetic Image

Synthetic Images II

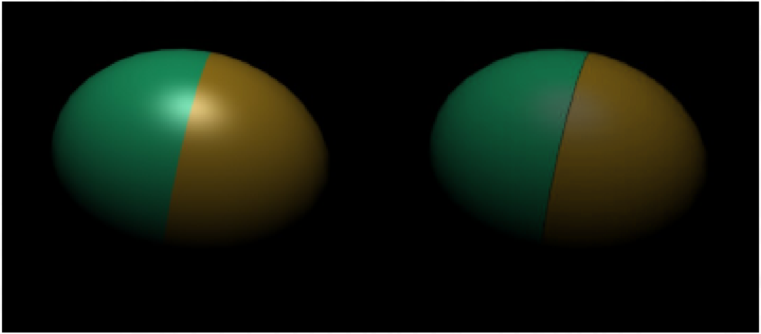


Figure: synthetic Image

Outline

Natural Images I

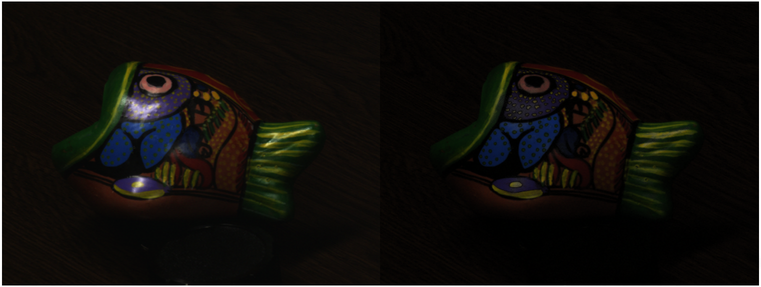


Figure: Natural Image

Natural Images II

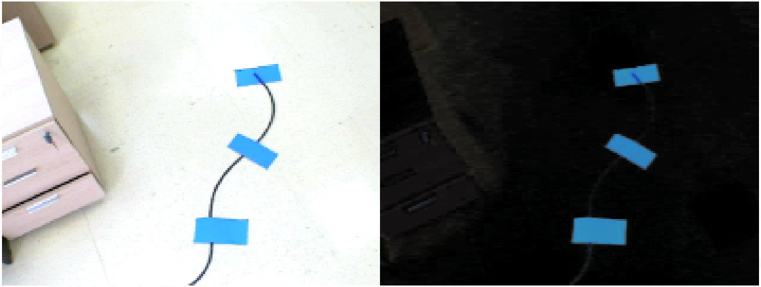


Figure: Natural Image

Natural Images III

Figure: Natural Image

Outline

A Detection Test

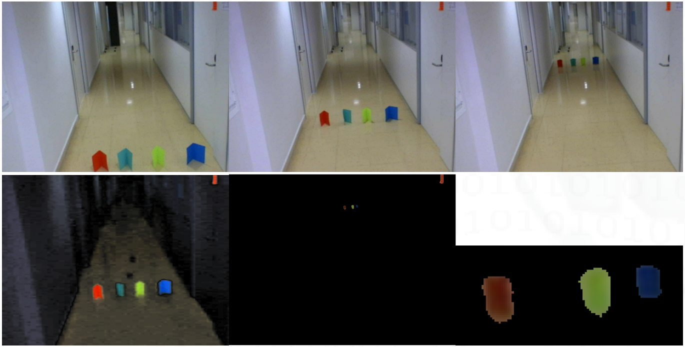


Figure: Din A4 Color Paper detection

A Detection Test

Milestone	4	5	6	7	8	9	10	11	12	13	14	16
D. in m.	8.4	10.8	12.8	14.5	17.3	20.7	26.2	31.7	36	41.9	46	50
Label 1	×	×	×	×	×	×	×		×	+	×	
Label 2	×	×	×	+								
Label 3	×	×	×	×	×	×	×	×	×	+	×	
Label 4	×	×	×	×	×	×	+					

Table: Measures

Outline