# Color Image Segmentation using A-IFSs

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CITAB - UTAD

2008

# Outline

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# Methodology for Gray Images

## General framework

We will associate each pixel with three numerical values:

1. A value for representing its membership to the background, which we will interpret as the expert's knowledge of the membership of the pixel to the background.
2. A value for representing its membership to the object, which we will interpret as the expert's knowledge of the membership of the pixel to the object.
3. A value for representing the unknowledge/ignorance of the expert in determining the membership functions described in the first two items. This value will be represented by Atanassov's intuitionistic index.

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# Methodology for Gray Images

## Algorithm

1. Construct $L$ fuzzy sets $\tilde{Q}_{Bt}$ associated with the image $Q$.
2. Construct $L$ fuzzy sets $\tilde{Q}_{Ot}$ associated with the image $Q$.
3. Represent the unknowledge/ignorance of the expert in the construction of the fuzzy sets $\tilde{Q}_{Bt}$ and $\tilde{Q}_{Ot}$ by means of Atanassov's intuitionistic fuzzy index $\pi$.
4. Construct the $L$ A-IFSs $Q_{Bt}$ and $L$ A-IFSs $Q_{Ot}$ associated with the image $Q$.
5. Calculate the entropy $\varepsilon_T$ of each one of the $L$ Atanassov's intuitionistic fuzzy sets $Q_{Bt}$.
6. Take as best threshold the value of $t$ associated with the A-IFSs $Q_{Bt}$ of lowest entropy $\varepsilon_T$.

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4. 
5. 
6. 

### Steps 1 and 2

$$\mu_{\tilde{Q}_{Bt}}(q) = F\left(d\left(\frac{q}{L-1}, \frac{m_B(t)}{L-1}\right)\right)$$

$$\mu_{\tilde{Q}_{Ot}}(q) = F\left(d\left(\frac{q}{L-1}, \frac{m_O(t)}{L-1}\right)\right)$$

with,

$$m_B(t) = \frac{\sum_{q=0}^{t} qh(q)}{\sum_{q=0}^{t} h(q)} \qquad m_O(t) = \frac{\sum_{q=t+1}^{L-1} qh(q)}{\sum_{q=t+1}^{L-1} h(q)}$$

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### Step 3

$$\pi(q) = \wedge\left(1 - \mu_{\tilde{Q}_{Bt}}(q), 1 - \mu_{\tilde{Q}_{Ot}}(q)\right)$$

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2. [illegible]
3. [illegible]

### Step 4

$$Q_{Bt} = \{(q, \mu_{Q_{Bt}}(q), \nu_{Q_{Bt}}(q)) | q = 0, 1, \cdots, L-1\}, \text{ given by}$$
$$\mu_{Q_{Bt}}(q) = \mu_{\tilde{Q}_{Bt}}(q)$$
$$\nu_{Q_{Bt}}(q) = 1 - \mu_{Q_{Bt}}(q) - \pi(q)$$

4. and

$$Q_{Ot} = \{(q, \mu_{Q_{Ot}}(q), \nu_{Q_{Ot}}(q)) | q = 0, 1, \cdots, L-1\}, \text{ given by}$$
$$\mu_{Q_{Ot}}(q) = \mu_{\tilde{Q}_{Ot}}(q)$$
$$\nu_{Q_{Ot}}(q) = 1 - \mu_{Q_{Ot}}(q) - \pi(q)$$

5. [illegible]
6. [illegible]

A-IFSs $Q_{Bt}$ of lowest entropy $\varepsilon_T$.

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### Step 5

$$\varepsilon_{T_2}(Q_{Bt}) = \frac{1}{N \times M} \sum_{q=0}^{L-1} h(q) \cdot \pi(q)$$

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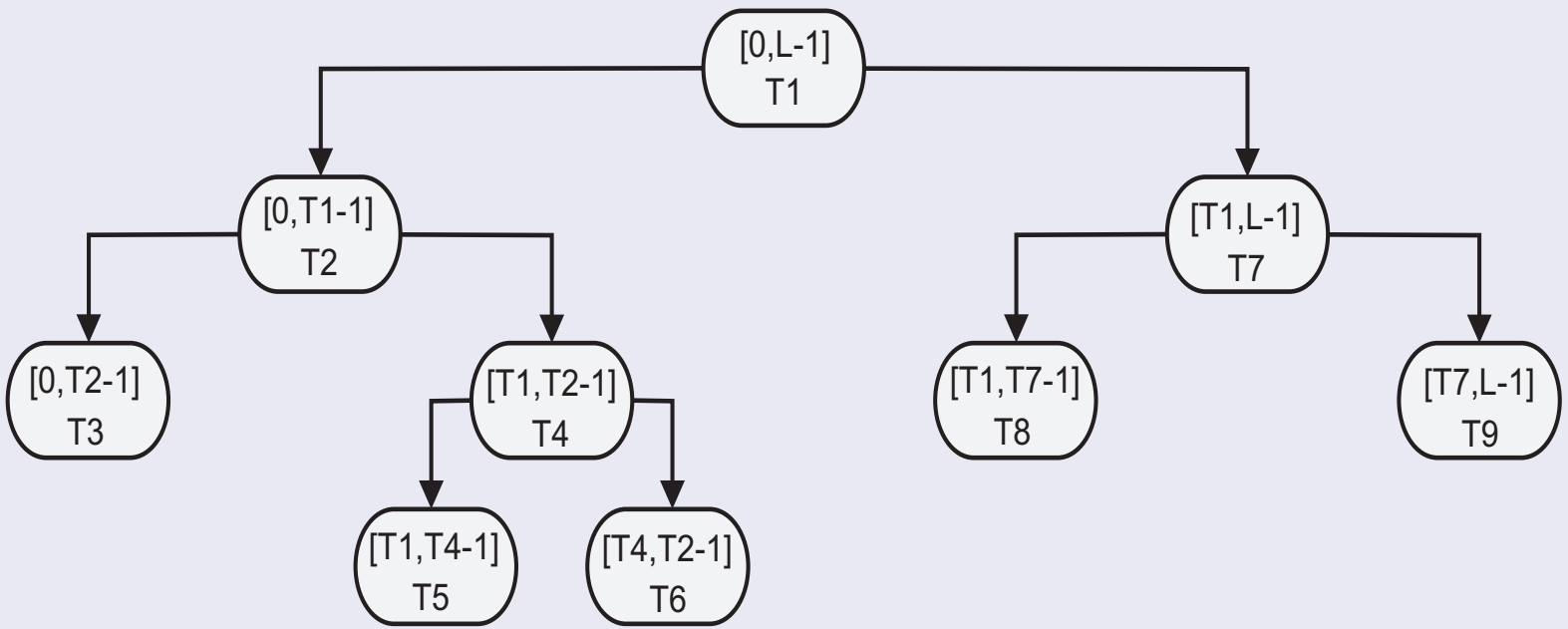
## General Framework



# Methodology for Gray Images

## Algorithm progress

The algorithm is to be applied to the sub-image which has the greater amplitude between gray-levels entropy values.

## Stopping criteria

The algorithm stopping criteria is based on the sub-images gray-levels global and local entropy values.

# Outline

# RGB vs HSV

## RGB major drawbacks

Each RGB component is treated independently making it impossible to achieve a coherent segmentation over the global color spectrum.

1. Big correlation between all three components.
2. Perceptual nonuniformity.

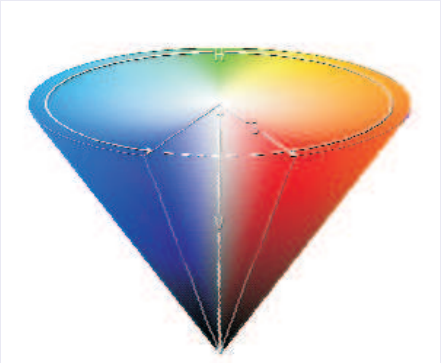
## HSV major advantages

The HSV color space is a linear transformation of the RGB color space.

1. Intuitive color space.
2. Closely related with human perception of color.

# Modified HSV Color Space

## HSV Transformation



TRANSFORMATION

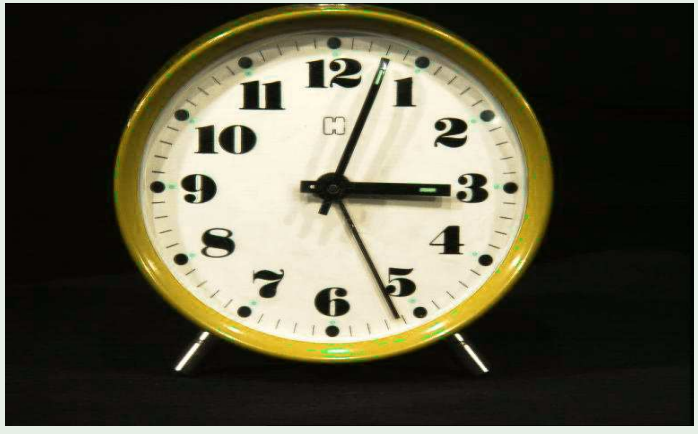

HISTOGRAM

# Results

## Example

Original

Segmented (3 ths)



Original

Segmented (3 ths)

# Results

## Example

Original

Segmented (3 ths)

Original

Segmented (3 ths)

# Results

## Example

Original

Segmented (4 ths)

Original

Segmented (6 ths)

# Conclusions and Future Work

## Conclusions

The methodology used in gray images was successfully adapted to color image segmentation.

## Future Work

1. To explore the use of other entropies within the general methodology.
2. To explore the incorporation of the S and V components in the methodology.
3. To develop more intuitive way of showing the results of the segmentation.