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Development of an innovative device for high performance tracking measures

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Summary. — In this paper we present a new Weighting Resistive Matrix (WRM) capable of working for a CCD output. The basic idea is that the luminosity of the pixels defines the position error of the pixel itself. In order to reach this outcome, a variable dispersion is performed. A simple way to obtain this is to vary the dispersion width as a function of the input signal's frequency, proportional to the luminosity of the pixel. This is achieved adding a capacitor to the WRM cell. This new design is capable of performing the straight line fit with a variable position error, as a function of the luminosity.

1. – The Weighting Resistive Matrix (WRM)

1˙1. *The device*. – The WRM hardware topology (see [1] for details) is an $N \times K$ matrix of inputs with N outputs. It is a simple resistive voltage divider (two constituent resistors labelled $R_{w,s}$), looped N times and adapted in both sides, making up a *strip*.

Each node between R_w and R_s is an input node. Each strip is linked to the next one by N *roads* for K strips and each road to the output node.

1˙2. *Operative principles*. – A digital input, that could reflect the state of an ideal detector, brings to a diffusion effect for each strip summed up by the N roads. This process could be seen as a fit with two important operative principles:

- *The set of roads*, which defines the set of the theoretical patterns that have to be accepted by the trigger logic.
- *A "confidence" rule*, which defines when the experimental patterns fit with the theoretical patterns.

The highest value of the dispersion discriminates one or more correct theoretical patterns/roads and the width dispersion defines the confidence rule.

Because of its passive nature, the WRM is costless and extremely fast. It introduces a hardware non-integer weighted sum able to detect tracks and segments from an image with great performances already simulated and tested [2].

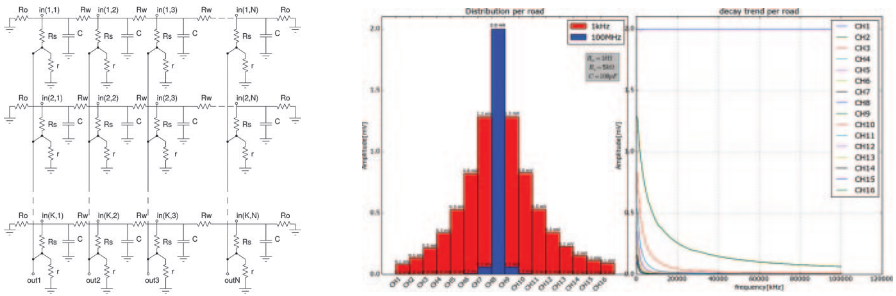

Fig. 1. – The AWM schematic (left; equal to WRM schematic except for a capacitance) and the output of one firing road for two different frequency sinusoidal inputs (right).

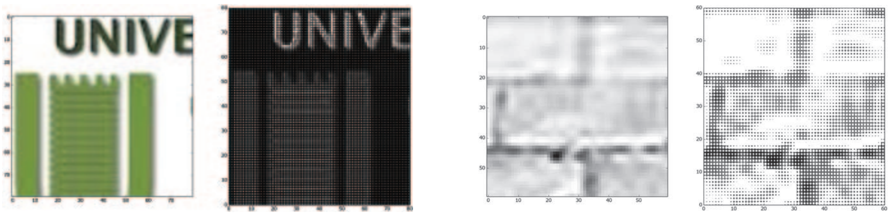

Fig. 2. – The simulated AWM application. Original and processed version are compared for two sample images.

2. – The Analog Weighting Matrix (AWM)

In order to analyse analog inputs with the WRM principles, the AWM (fig. 1) has been designed. The analog inputs, with the AWM track's fit, are conceptually associated to an *error of measure* in the fit itself.

2·1. *Operative principles*. – The AWM keeps all the good properties of the WRM in terms of power consumption and speed process but could perform a variable dispersion per strip as a function of the frequency of the input signal.

2·2. *Image processing*. – A direct example with image processing has been done. If the physical quantity associated to the input frequency signal is the light intensity of a pixel in a image, then the AWM is able to discriminate spatial correlations as a function of pixel's intensity (in fig. 2 two processed real images are shown).

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