Curso de Doctorado

Doctorado en Ingeniería Matemática—UCM

Doctorado en Investigación Matemática—UCM

Mención hacia la excelencia MEE2011-0021

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The partial differential equations of image processing (and their surprising applications to today's life)

Abstract

As hinted by the prominent role that evolution has given to vision in our brain, most human activities rely on visual perception.

Most human information media use images and video. It is even more so for scientific and technical activities, which rely on the creation or acquisition of images and their analysis. They are for example indispensable in medicine, astronomy, material science and biology.

In this booming context, image processing has developed as an autonomous science in the past 30 years. Its goal is to define the structure of digital images, to acquire them, to improve their quality, to compare them, and to extract information from them.

Unsurprisingly, each image being a continuous medium, calculus plays a prominent role in these operations. The most basic operations on images rely on variants of the simple partial differential equations that also appear in continuum mechanics.

While the equations are simple, their use is both subtle and funny. In this short course, I'll try to develop some of these uses. I'll give for each usage the theory, but also the complete algorithm, and demonstrate it on real images in experimental sessions on the online journal IPOL www.ipol.im. The tentative programme follows.

Lecture 1: Fourier analysis and the fundamentals of its application to digital images
Lecture 2: Poisson editing: how to perform a magic copy-paste on images
Lecture 3: Retinex theory: from color perception to the restoration of photographs with backlight
Lecture 4: The heat equation, sampling and scale invariance: simulating image zooms
Lecture 5: The SIFT method comparing any two images and deciding if they see the same objects

These lectures will be dedicated to the dear memory of Vicent Caselles, who contributed to the foundation of image science.

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Horario: Consultar en las webs
http://www.mat.ucm.es/~docinvesmat/
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