Image Space

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Abstract

"Image Space" is composed of a substrate, for instance the "image plane", with a conventional structure, for instance the Euclidian plane, times a space of "values". In the simplest case the values are "image intensities", or "pixel values". An "image" is then understood as a cross section, or surface, one value for each point in the base space. The structure of the value domain is often unclear in conventional image processing. Physical reasoning suggests that the value domain has the structure of an affine line. Since the base space and the value domain are incommensurable, their dimensions cannot be mixed. Otherwise default image space is homogeneous. This suggests that it be treated as a Cayley-Klein space with a single isotropic dimension. The differential structure of images can only be defined in the context of one or more finite scales, since the "value at a point" cannot be operationally defined. Thus images are not differentiable. Differentiation is implemented via convolution with derivatives of the kernel that implements the scale, or resolution. This allows one to implement exact differential invariants, albeit at a scale. Geometrical loci also have to be understood in this way. They become fuzzy characteristic functions, that is, again images. "Differential geometry of images" becomes a particular image algebra. This type of structure is useful in technical "image processing" for various applications (e.g., medical image processing), but - perhaps more interesting - the cortex has all of the features of an image processor of this kind, leading us to speculate that the brain contains various "geometry engines".