

(Infinite) Image Definitions

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Abstract. The purpose of this article is to give new insight in the Image field by introducing accurate definitions for images. The range of these definitions -as well as the properties presented herein- extends along diverse fields of Science as well as of Nature. They also construct a bridge between analog and digital image, as a matter of inheritance (from analog to digital), transformation, processing, applications etc. The fundamental concept of the essay is the *theorem of infinite Image definitions*. We introduce herein this theorem which results in (a) discovery and exploration of the Image scientific area, (b) conception of innumerable scientific definitions, (c) highlight of the critical impact of diverse sciences on the Image science, etc. Moreover, we present some new, but very important, image properties, as an immediate supplement of the basic theorem of definitions. They contribute to the deeper understanding of the fundamentals of the Image and they reveal useful attributes for numerous applications in this field. This essay raises promising interdisciplinary understanding, processing and exploitation of the Image.

Keywords: Image definition-Image properties-Bandlimitedness theorem

1. Introduction

A strong interconnection between Image and Culture, or even Image and the wider space of Civilization [9], can be observed. Moreover, we may consider the important relation of Image to Science. Finally, we should of course declare the inherent connection between Image and Nature. Although image is a small-extend piece of information (*land of information*), it is however a whole cosmos; a cosmos of Civilization. This remark could be assigned to each individual image.

In this paper we prove that there are infinite possible definitions for Image. Moreover we give thirty such definitions, as well as some fundamental properties of it.

2. Image Definitions

What is an image? Some plausible definitions among the huge (innumerable) set of such definitions are given in this chapter. We initially introduce the following theorem relative to the enumeration of image definitions.

Theorem of Image Definitions: The number of (all the) possible image definitions is infinite.

Proof. We assume an n-dimensional image in R^n . We can also assign $m \rightarrow \infty$ identities to each image element, thus defining the set of identities I_m . (As image identities we may assume for instance hue, brightness, derivatives etc.). In this way, there are infinite combinations regarding the image and they are given by the Cartesian product $R^n \times I_m$. There exist therefore infinite possible definitions, when the hyperspatial distribution of the aforementioned identities is assumed; at least one definition for each combination. †

By the term ‘image’ we refer to the physical as well as to the manmade image (digital etc.) [5]. We extend the domain of definitions to the space spanned by diverse scientific fields. In this way a huge scientific collection of definitions (*Collection of Image Definitions*) is generated. Moreover the interdisciplinary determination of the Image is introduced as well. Thus Image-related sciences will obtain multivariate scientific criteria regarding the framework of this relation. It is also useful to consider the classification of images into the following two wide categories:

- a. physical (photographs, paintings etc.)
- b. ideal (or fantastic).

We give now an introductory corpus of such definitions. We cite in brackets (in alphabetic order) the general scientific area wherein each definition belongs.

2.1 Collection of Image Definitions (*CollImaDe*¹)

1. [Civilization] An image is a cosmos of Civilization.
2. [Civilization (Physical/Artificial)] Images are cosets [11] of Arts, Culture and Nature.
3. [Cosmology] (a) A physical image is a window to a region of Cosmos.
(b) Image is a fragment of Cosmos.
4. [Databases] An image is a database of visual information.
5. [Geometry] Images are geometrical arrangements and distributions of optical information.
6. [Geometry (Hyperspace)] Images can be projections of hyperspaces (N-D spaces).

¹ The acronym ‘*CollImaDe*’ is used as a slight alteration of the word ‘*collimate*’ to describe the parallel use of definitions in order to more accurately define the Image (in analogy with light rays producing collimated light).

7. [Graph Theory [1]] An image defines a graph.
8. [Image Processing (Resolution)] Image is vision of Nature constrained by visual resolution.
9. [Infinity] Images are visual limitations of the infinity.
10. [Information] An image is a space ('land') of information.
11. [Information (Distribution)] Image as a whole is the (visual) information of the Cosmos which is stratified and distributed over the range from the ultimate microcosm (μC) to the ultimate Macrocosm (MC). (Fig.1)
12. [Information (Representation)] An image is a visual representation of information [8].
13. [Life] Image is (partial) icon of the life.
14. [Mathematics] Images are visible mathematical models.
15. [Mathematics (Set Theory)] An image is a space-limited set of visible elements.
16. [Mathematics (Spaces)] Images are subspaces of Euclidean spaces.
17. [Ontology [2]] The image is the illustrative character of things.
18. [Ontology] The image is the depiction (or the shell) of real information (content).
19. [Optics] Image is a non-empty optical field.
20. [Optics (Vision)] The image is the conjugate part in the vision system (eye-image).
21. [Phenomenology] An image is a description of things.
22. [Philosophy] An image is damage of utopia.
23. [Physics] Image is Nature observed under the physical constraints of the observer.
24. [Psychology] An image is a source of psychological stimulation and impact [3].
25. [Real World] An image is a heterogeneous transcription of the real world (*physical to artificial*).
26. [Sampling [6]] The image is an infinite or finite assemblage of optical samples (analog or digital image, respectively).
27. [Systems] An image is a two-fold system: a visible (external) and a hidden (internal) one.
28. [Text] An image is a depictive text.
29. [Topology] An image defines a topology.
30. [Universe] The Whole Image (WI) is assigned to the Universe.

3. Image Properties

We now proceed by giving some fundamental properties of an image, as a necessary supplement to the previous definitions.

Bandlimitedness Theorem (I). Every image other than the (image of the) Universe is spatially non-Bandlimited (BL).

Proof. Indeed, each image is a truncated 2D or 3D function, i.e. it is space-limited. Therefore, according to the Uncertainty Principle [7], each image is non-BL. †

Theorem II. There are infinite physical images.

Proof. There are infinitely many subsets of the (vast) Universe and they of course can form several images in multiple ways. Thus infinite physical images result. †

Corollary I. There is even an image which is a subset of a given image.

Proof. Indeed we may divide an image in even smaller sub-images until we reach the ultimate (yet known) smallest image. However, we theoretically know that even smaller (particle) images do exist (see for instance the LHC experiments at CERN [4]).

Corollary II. There is ever an image which is a superset of a given image.

Proof. This is a corollary of the last definition (30) regarding the Whole Image. The ultimate superset is that of the WI.

4. Conclusion

The aforementioned definitions lead to many new statements, revealing the unknown nature of the Image. They also introduce scientific criteria for an interdisciplinary field of image transactions. Moreover the given properties can illuminate yet unknown, or fussy, mechanisms and processes in image study.

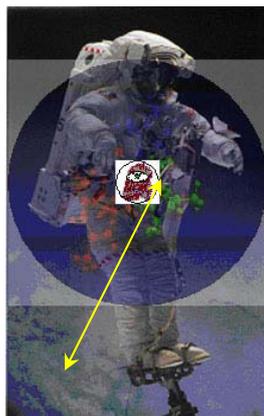


Figure 1. Image: from microcosm to Macrocosm
[Part of the image is taken from [10]]

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