

The Differential Geometry of the Consciousness

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Abstract

Our visual perception places us at the origin of a 3-dimensional cartesian coordinate system. On a cosmological scale, the consciousness (as manifested in the brain) can be approximated as point like. It is proposed that perceptual experiences can be regarded as occurring on a tangent space at the point where the consciousness is located. A differential geometric framework is developed, for consciousness propagating on a curved space-time manifold.

1. Introduction

Differential Geometry [1] has been used successfully in modeling objects such as black holes [2], and universes with various metrics and matter distributions [3]. Here in, we develop a differential geometric frame work for modelling the consciousness. Our visual perception places us at the origin of a 3-dimensional cartesian coordinate system. On a cosmological scale, we can indeed be considered as points. The consciousness, denoted as C is considered to be localized on to a point, which we will denote as p . Due to our psychological experience of time asymmetry [4,5], we have the ansatz that, C is traversing irreversibly along the future time-like direction – on the (3+1) dimensional space-time manifold $M_{3,1}$. In general, the space-time manifold is curved and may have a non-trivial topology. So, the space of perception can be regarded as existing on a tangent space located at the point p . We will denote this Tangent space as T_p^C , i.e., - the ‘Perceptual Tangent Space of the Consciousness C , located at p . In general, multiple consciousness’ –

$$C_1, C_2, \dots, C_k$$

can be regarded as located on a series of points –

$$p_1, p_2, \dots, p_k$$

on $M_{3,1}$.

Our approach of flat perceptual tangent space consciousness, has some similarity with dualistic view of Sir Eccles [6] – the dual entities being –

- (1) matter existing on $M_{3,1}$, and
- (2) The $T_{p_i}^{C_i}$, the perceptual tangent spaces of consciousnesses.

2. The Perceptual Tangent Space.

We define a map f_i , which takes points on $M_{3,1}$ to points on $T_{p_i}^{C_i}$. Under this mapping, a neighborhood N_{p_i} of p_i , on $M_{3,1}$ can be mapped on to a neighborhood on $T_{p_i}^{C_i}$ –

$$f_i: N_{p_i} \rightarrow N_{p_i}^{T_{p_i}^{C_i}}$$

The physical body associated with C_i on $M_{3,1}$ will be referred to as $B_3^{C_i}$ – where the subscript 3 indicates the dimensions. Its geometrical (spatial) extent would be referred to as $G_3^{C_i}$, whose 2 dimensional surface is $\partial G_3^{C_i}$. Their mapping onto the Tangent space is $f(G_3^{C_i})$ and $f(\partial G_3^{C_i})$. Due to - (1) Our motor abilities, (2) Irreversible passage of time; these objects are time dependent and may be written as $G_3^{C_i}(t), B_3^{C_i}(t), f_i(G_3^{C_i}(t)) \partial G_3^{C_i}(t)$; where t is the time. As consciousness C_i moves around in the space-time continuum $M_{3,1}$, $G_3^{C_i}$, the tangent space of consciousness $T_{p_i}^{C_i}(t)$ also moves accordingly. We can associate a world line l^{C_i} , parameterized by t , for temporal evolution of consciousness C_i . Thus, we have the fiber bundle –

$$\mathcal{F} = T_{p_i}^{C_i} \times l^{C_i}$$

In general, we have five senses, namely – sight, sound, taste, smell and touch. Each of them differs in –

- (1) The physics of the interface between external world and the body, and
- (2) Processing of the input by the brain, and its extension – the nervous system.

Let $V_{p_i}^+$ and $V_{p_i}^-$ be the future and the past light cones at p_i respectively. Our visual, perceptual experience is limited to absorption of light emitted in the past – and subjected to the processing by the eyes and the brain. Further, it is a subset of the solid angle of 4π Sr, an approximately 60° cone. What is coming into eyes is a stream of photons. Thus, if \mathcal{A} is our visual experience, of an object on $M_{3,1}$, we have –

$$\mathcal{A} \subset T_{p_i}^{C_i} \subset f_i(V_{p_i}^-)$$

Let,

$$O_i, O_j, \dots, O_m$$

be objects lying on $V_{p_i}^-$. Let, $\mathcal{P}_l^i(O_l)$ be the set of photons streaming from O_l into the eyes of the consciousness C_i . Let \mathcal{B}^{Vision} , be the processing by eyes and brain – leading to a sensed object in the Visual tangent space. \mathcal{B}^{Vision} stands for the processing which starts in retina; then information going via optic nerves to the Optic Chiasm; then splitting into left half and right half of the visual field; then optic radiation going into occipital cortex; visual Brodmann areas; then coming forward and finally coming into the conscious awareness. Then for each O_l we have –

$$\mathcal{B}^{Vision}(\mathcal{P}_l(O_l)) \subset T_{p_i}^{Vision}$$

And reciprocally the Perceptual Tangent Space is union of all such images of the objects, in the consciousness -

$$T_{p_i}^{Vision} = \bigcup_{l=1}^m \mathcal{B}^{Vision}(\mathcal{P}_l(O_l))$$

Note has to be made of the visual perception of the written words – which is processed in association areas of visual and lingual areas.

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