Stochastic control versus forces and force carriers

by Hans van Leunen

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Abstract

The Quantum Field Theories apply forces and force carriers to control binding, while the Hilbert Book Model applies stochastic processes to control coherence and binding. The stochastic approach is easier comprehensible and achieves similar results. The document compares both approaches.

1 The universe as a field

Fields can be described by quaternionic functions. In the universe several basic fields are active. The universe itself is a field that is always and everywhere present. This field carries or embeds all discrete objects that exist in the universe. It coexists with other basic fields. All fields obey the same quaternionic differential equations that describe their dynamic behavior. The basic fields distinguish in their start and boundary conditions.

The field equations describe interactions between fields and point-like actuators, such as pulses, sources and sinks.

2 Field equations

Quaternionic differential calculus applies the quaternionic nabla operator ∇. This calculus uses proper time τ, where Maxwell equations apply coordinate time t.

$$\nabla \equiv \nabla_r + \boldsymbol{\nabla}$$

$$\boldsymbol{\nabla} \equiv \{\partial/\partial x, \partial/\partial y, \partial/\partial z\}$$

$$\nabla_r \equiv \partial/\partial \tau$$

In the quaternionic differential calculus differentiation is a multiplier operation:

$$\phi = \phi_r + \boldsymbol{\phi} = \nabla\psi \equiv (\nabla_r + \boldsymbol{\nabla})(\psi_r + \boldsymbol{\psi}) = \nabla_r\psi_r - \langle\boldsymbol{\nabla}, \boldsymbol{\psi}\rangle + \boldsymbol{\nabla}\psi_r + \nabla_r\boldsymbol{\psi} \pm \boldsymbol{\nabla}\times\boldsymbol{\psi}$$

$$\phi_r = \nabla_r\psi_r - \langle\boldsymbol{\nabla}, \boldsymbol{\psi}\rangle$$

$$\boldsymbol{\phi} = \boldsymbol{\nabla}\psi_r + \nabla_r\boldsymbol{\psi} \pm \boldsymbol{\nabla}\times\boldsymbol{\psi}$$

Double differentiation leads to the quaternionic second order differential equation:

$$\zeta = \nabla^*\phi = (\nabla_r - \boldsymbol{\nabla})(\nabla_r + \boldsymbol{\nabla})(\psi_r + \boldsymbol{\psi}) = \{\nabla_r\nabla_r + \langle\boldsymbol{\nabla}, \boldsymbol{\nabla}\rangle\}(\psi_r + \boldsymbol{\psi}) = \rho_r + \boldsymbol{J}$$

$$\zeta = \{\nabla_r\nabla_r + \langle\boldsymbol{\nabla}, \boldsymbol{\nabla}\rangle\}\,\psi$$

The equation can be split into two first order partial differential equations $\phi = \nabla\psi$ and $\zeta = \nabla^*\phi$

This equation offers no waves as its solutions. The quaternionic equivalent of the wave equation is:

$$\varphi = \{\nabla_r\nabla_r - \langle\boldsymbol{\nabla}, \boldsymbol{\nabla}\rangle\}\,\psi$$

The homogeneous version of this equation offers waves as its solution:

$$\nabla_r \nabla_r \psi = \langle \nabla, \nabla \rangle \psi = -\omega^2 \psi$$

Corresponding Maxwell-like equations are:

$$\mathbf{E} = -\nabla \psi_r - \nabla_r \boldsymbol{\psi}$$

$$\mathbf{B} = \nabla \times \boldsymbol{\psi}$$

$$\rho_r = \langle \nabla, \mathbf{E} \rangle$$

$$\mathbf{J} = \nabla \times \mathbf{B} - \nabla_r \mathbf{E}$$

$$\nabla_r \mathbf{B} = -\nabla \times \mathbf{E}$$

The corresponding second order differential equations are:

$$\{\nabla_r \nabla_r - \langle \nabla, \nabla \rangle\} \boldsymbol{\psi} = \mathbf{J}$$

$$\{\nabla_r \nabla_r - \langle \nabla, \nabla \rangle\} \psi_r = \rho_r$$

3 Modular construction

All massive objects in the universe are modules. All massive modules are either elementary modules, or they are composed modules, or they are modular systems. Thus, together the elementary modules constitute all other massive modules and some modules constitute modular systems.

3.1 Defining dark objects

Dark objects are field excitations. Point shaped pulses generate these excitations. The effect of dark objects is so tiny that in isolation these objects can in no way be observed. And that includes detection by the most sophisticated equipment. That does not mean that these objects cannot become noticeable when they operate in huge coherent ensembles. In fact, all discrete objects in the universe are constituted by these dark objects.

Dark objects were already described theoretically more than two centuries ago. They are pulse responses that are solutions of second order partial differential equations.

Two second-order partial differential equations describe the behavior of dark objects.

$$\varphi = (\partial^2/\partial\tau^2 \pm \langle \nabla, \nabla \rangle)\psi$$

A third equation skips the first term

$$\varphi = \langle \nabla, \nabla \rangle \psi$$

This is the Poisson equation.

In fact, these equations are quaternionic differential equations. Thus, φ and ψ are quaternionic functions that own a scalar real part and an imaginary vector part. The solutions are quaternionic functions.

The equation using the – sign is the quaternionic equivalent of the wave equation. The equation using the + sign splits into two quaternionic first order partial differential equations. This second equation does not offer waves as solutions.

The dark objects behave as shock fronts and operate only as odd dimensional field excitations. During travel, all shock fronts keep the shape of the front.

3.1.1 One-dimensional shock fronts

The one-dimensional shock fronts also keep their amplitude. Consequently, the one-dimensional shock fronts can travel huge distances without losing their properties. Combined equidistantly in strings they represent the functionality of photons. This means that the one-dimensional shock fronts are the tiniest possible packages of pure energy.

Depending on the PDE the solutions can be described by different equations. The solution for the wave equation is

$$g(\mathbf{q},t)=f(c\,\tau \pm |\mathbf{q}-\mathbf{q}_\circ|)$$

This solution cannot represent polarization.

The solution for the other equation is

$$g(\mathbf{q},t)=f(c\,\tau \pm |\mathbf{q}-\mathbf{q}_\circ|\,\mathbf{i})$$

The vector $\mathbf{i}$ can indicate the polarization of the shock front.

A photon is a string of equidistant energy packages that obeys the Einstein-Planck relation

$$E = h\,\nu.$$

Since photons possess polarization, they use the second solution for their energy packages. Thus, the constituents of photons are not solutions of the wave equation.

3.1.2 Green's function

One of the solutions of the Poisson equation is the Green's function

$$g(\mathbf{q})=1/|\mathbf{q}-\mathbf{q}_\circ|$$

$$\nabla g(\mathbf{q})=(\mathbf{q}-\mathbf{q}_\circ)/|\mathbf{q}-\mathbf{q}_\circ|^3$$

$$\langle\nabla,\nabla\rangle\, g(\mathbf{q})=\langle\nabla,\nabla g(\mathbf{q})\rangle=4\pi\delta(\mathbf{q}-\mathbf{q}_\circ)$$

Thus, the Green's function is a static pulse response under purely isotropic conditions.

3.1.3 Three-dimensional shock front

The three-dimensional shock fronts require an isotropic trigger. These field excitations integrate over time into the Green's function of the field. That function has some volume, and the pulse response injects this volume into the field. Subsequently, the front spreads the volume over the field. The corresponding solution of the wave equation is

$$g(r,\tau)=f(c\,\tau \pm r)/r$$

The parameter r is the radius of the spherical front.

Thus, the initial deformation quickly fades away. but the expansion of the field stays. Having the capability to deform the carrier field corresponds to owning a corresponding amount of mass. This means that temporarily, the spherical pulse response owns some mass. This mass vanishes, but the expansion stays.

A huge coherent recurrently regenerated swarm of spherical pulse responses can generate a significant and persistent deformation that moves with the swarm. This happens in the footprint of elementary particles. The spherical pulses are generated by the hop landing locations of the particle. The hopping path forms a hop landing location swarm that is described by a location density distribution. This distribution equals the square of the modulus of the wavefunction of the particle.

The Hilbert Book Model supposes that all elementary modules are field excitations that are generated by point-like actuators. In addition, it supposes that all discrete objects in the universe are constituted by field excitations that are generated by point-like objects. The elementary modules are generated by pulses that result in spherical pulse responses. The other fundamental objects are generated by pulses that generate one-dimensional pulse responses. All fundamental pulse responses are shock fronts. These shock fronts only operate in odd dimensions. During travel the shock fronts keep the shape of the front. The one-dimensional shock fronts also keep the amplitude of the front. The effect of the shock fronts is so tiny, that in isolation these field excitations cannot be detected.

Initially, the spherical pulse responses deform their carrier field. Over time they integrate in the Green’s function of the field and the pulse injects the volume of this function into the field. This expands the field and it temporarily deforms the field. The front spreads the volume over the field. Thus, the deformation quickly fades away. Deformation of the carrier field corresponds to owing some mass. Thus, spherical shock fronts temporarily own some mass that quickly vanishes.

3.1.4 Stochastic generation of elementary modules

The mechanism that manages the footprint of elementary modules keeps generating new hop landing locations that constitute the hopping path of the elementary module. This mechanism is a stochastic process that owns a characteristic function, which equals the Fourier transform of the location density distribution of the generated hop landing location swarm. Thus, the spatial part of the what the mechanism generates is controlled via a spatial spectrum. This spectrum controls the coherence of the generated hop landing location swarm. If the spectrum widens, then the spread in configurations space gets thinner. This explains the effect of Heisenberg’s uncertainty principle.

The hop landing locations recurrently form a coherent hop landing location swarm. A location density distribution describes this swarm and equals the square of the modulus of the wavefunction of the elementary module. Consequently, the footprint of the elementary particle persistently deforms the carrier field and this deformation travels with the elementary particle. The deformation nearly equals the convolution of the location density distribution and the Green’s function of the field. The equality does not hold exactly because the overlap of the individual deformations depends on the density of the swarm and on the speed at which the individual deformations fade away. Far from the center of the swarm the shape of the combined deformation becomes the shape of the Green's function of the field. There the form of the deformation can be described by the gravitation potential V

$$V=G\ M/r$$

Here M is the mass of the elementary module, r is the distance of the gravitational center of the deformation and G is a proportionality constant that converts to physical units.

If the location density distribution equals a normal distribution, then the characteristic function is a Gaussian distribution. In this case the deformation will approach the shape

$$V = G\ M\ ERF(r)/r$$

Already at a small distance of the geometric center this shape will approach

$$V=G\ M/r$$

This does not equal the convolution of the Green's function and the Gaussian distribution

$$ERF(r)/r$$

because density of the swarm is not high enough and the Green's function fades away faster than it is regenerated.

3.2 Forces

In contrast to the ease that describes the interaction between the stochastic process and the embedding field the description of the residing forces is very complicated. We use the formula for the gravitation potential to derive the gravitational force. This involves the introduction of a new quaternionic field that represents the change of the moving gravitation potential. It consists of two parts. The first part is the scalar gravitation potential ζ_r. The second part is the uniform speed of the moving gravitation potential $\boldsymbol{\zeta} = \mathbf{v}$. By recurrently regenerating the hop landing location swarm, the stochastic process tries to keep the total change of this field equal to zero.

$$\xi = \xi_r + \boldsymbol{\xi} = \nabla\zeta \equiv \nabla_r\, \zeta_r - \langle \boldsymbol{\nabla}, \boldsymbol{\zeta} \rangle + \boldsymbol{\nabla}\, \zeta_r + \nabla_r\, \boldsymbol{\zeta} \pm \boldsymbol{\nabla} \times \boldsymbol{\zeta} = 0$$

This reduces to

$$\nabla_r\, \boldsymbol{\zeta} + \boldsymbol{\nabla}\, \zeta_r = 0$$

$$\nabla_r\, \boldsymbol{\zeta} = \partial \mathbf{v}/\partial\tau = \partial \mathbf{v}/\partial\tau$$

$$\boldsymbol{\nabla}\, \zeta_r = \boldsymbol{\nabla}(G\ M/r) = -G\ M\ \mathbf{r}/|\mathbf{r}|^3$$

Thus

$$(\partial \mathbf{v}/\partial\tau) = \mathbf{a} = G\ M\ \mathbf{r}/|\mathbf{r}|^3$$

The force **f** on mass m_2 that is centered at location $\mathbf{q}_2$ in a gravitation potential that is generated by mass m_1 that is centered at location $\mathbf{q}_1$ equals

$$\mathbf{f} = m_2\, \mathbf{a} = m_1\, m_2 G\ (\mathbf{q}_2 - \mathbf{q}_1)/|\mathbf{q}_2 - \mathbf{q}_1|^3$$

This procedure depends strongly on the knowledge that the stochastic process tries to keep the gravitation potential constant, while the platforms on which the masses reside try to keep their relative speed uniform. Travelling with uniform speed is the normal condition for the platform on which the elementary particle resides. The field ζ installs inertia by keeping its change zero. A sudden change of the uniform speed is compensated by a gradient of the gravitation potential. The procedure also uses the fact that the spherical shock fronts are solutions of the homogeneous second order partial differential equation can superpose and that far enough of the center of gravity the shape of the deformation equals the shape of the Green's function.

3.3 Symmetry related field

These facts also apply to the sources and sinks of the symmetry related field. It means that for this field a similar formula holds. However, a source attracts a sink.

$$\mathbf{f}=Q_2\,\mathbf{a} = -Q_1\,Q_2\,(\mathbf{q}_2-\mathbf{q}_1)/|\mathbf{q}_2-\mathbf{q}_1|^3$$

The charges Q_1 and Q_2 can be positive or negative. The sources and sinks can be interpreted as chains of spherical shock fronts that travel outward or inward.

$$g(q\,,\tau)=f(c\,\tau \pm |\mathbf{q}-\mathbf{q}_o|)/|\,\mathbf{q}-\mathbf{q}_o|$$

Here $\mathbf{q}_o$ is the location of the source or sink. In elementary particles this location coincides with the geometric center of the private parameter space of the platform of the elementary module.

The symmetry related field couples to the field that represents the universe via the geometric centers of the platform on which elementary particles reside

3.4 Composed modules

A second type of stochastic processes control the binding of components in composed modules. These stochastic processes also own a characteristic function. This characteristic function is a dynamic superposition of the characteristic function of the stochastic processes that control the components. The dynamic superposition coefficients act as displacement generators. In this way these superposition coefficients determine the internal positions of the components.

For each separate module a displacement generator determines the location of the module. This holds for elementary modules, for composed modules and for modular systems. Thus, the second type of stochastic process binds the components composed modules and modular systems such that they move as one unit. This binding is enforced by the gravitation forces and the attractive electrical forces that are exerted by the mass and the electric charge of the elementary components. The facts that the gravitation field can only work with purely isotropic pulses and that electric forces can also be repulsive complicate the binding process.

4 Weak and strong forces and force carriers

The Hilbert Book Model does not use weak or strong forces to explain the binding of the components in the composed modules. The HBM only considers gravitation forces and electric forces as influencers of the binding process. Quantum Field Theory starts at the Lagrange equation to derive the influence of weak and strong forces via a path integral.

The HBM can derive the Lagrange equations from the hopping path of elementary particles and the fact that the characteristic function of the first type of stochastic process controls the coherence of the recurrently regenerated hop landing location swarm. Further, the second type of stochastic process controls the binding of the components in a composed module or modular system.

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