Sticky Viscous Space Coverage

By J.A.J. van Leunen

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Abstract

Space can be covered with point-like objects. Space covered by a countable set of point-like objects behaves differently from space that is covered by an uncountable set of point-like objects.

Number systems and coordinate systems

In this document coordinate markers are applied to navigate between point-like objects that exist in otherwise empty space. The markers use identifiers that are borrowed from a number system. The location of a marker point need not coincide with the virtual location of the corresponding number. In the maiden state of the coordinate system, borrowing the identification means that the location of the coordinate marker is identical to the virtual location of the corresponding number.

We apply Cartesian coordinates and, in some cases, spherical coordinates because especially in multidimensional situations the events in local and global coordinates are easier comprehended by humans than local and global events in functions. In the maiden state of the coordinate system the coordinate markers locate at the same locations as the corresponding numbers. The relation between number system and coordinate system corresponds to the relation between a parameter space and the function that applies the parameter space.

The real number system

Counting and addition

We start with generating a suitable number system. This start involves the insertion of two point-like objects in a completely empty space. Completely empty space is synonym for complete nothingness. We shall see that a sticky medium is synonymous to a completely covered space. The first added point is the base point of a vector. The second point is the pointer of the vector. The vector has a length and a direction. The integrity of the vector is conserved when it is shifted in parallel as one unit to a different location. One possibility is that the vector is shifted along its direction line such that its base point takes the location of the pointer location of the original vector. This action creates a new vector that consists of the base point of the first vector and the pointer location of the second vector. The length of the third vector is twice the length of the first vector. All contributing points find a position at the same direction line. The contributing points act as counts and the shift installs the addition procedure. Repeating the shift and addition procedures generates the set of the natural numbers. The procedure of addition can be reversed into subtraction until the base point of the first vector is passed. This is reason to identify this point as the condition in which space is back to being completely empty; For that reason, this point is called zero. If reverse addition is taken further, then this action introduces negative integer numbers. Together with zero and the natural numbers this constitutes the set of the integer numbers.

Multiplication, division, and fractions

The following step is the introduction of multiplication by combining multiple additions of the same integer number. Multiplication with integer numbers does not introduce new numbers, but the reverse operation that we will call division can introduce new numbers that we call ratios. In this way, the number system is extended to the set of the rational numbers. All rational numbers except zero can be applied as a divisor. Scientists have shown that all rational numbers can be labelled with a natural number. This means that the set of rational numbers is still countable. This also indicates that all rational numbers are still surrounded by empty space.

Superseding countability

Up to so far, all rational numbers take a location on the same direction line. The square of a rational number is a multiplication of that number with itself. The result is a rational number. The reverse operation is called square root and this operation does not always result in a ratio. However, a converging series of rational numbers can approach the result arbitrarily close. Many numbers exist that are not rational numbers and can be approached arbitrarily close by converging series of rational numbers. We call these numbers irrational numbers. The set of irrational numbers is not countable. If the set of the rational numbers is merged with the set of the irrational numbers, then the set of real numbers results. The set of all real numbers completely covers the same direction line. If the set covers all irrational numbers, then around the real numbers no space is left.

Spatial dimensions

Different arithmetic

If we want to add all square roots of negative real numbers, then we must use one or three new direction lines that are independent of the direction line that is occupied by the real numbers. These direction lines cross at point zero. The arithmetic on these new direction lines differs from the arithmetic of the real number direction line. We call the new direction lines spatial direction lines. The real number direction line together with one spatial direction line forms the set of the complex numbers. The real number direction line together with three spatial direction lines form the set of the quaternions. Multiplying spatial numbers with real numbers is straightforward. In handling the arithmetic of multidimensional number systems, it is wise to treat the combined number as a sum of a real number and a spatial number.

On spatial direction lines, the square of the spatial numbers results in a negative real number. Spatial numbers can be natural, rational, and irrational. Also, in spatial dimensions the addition of all irrational numbers will supersede countability. The main difference between real numbers and spatial numbers lays in the value of the square of the numbers. In real numbers the square is always a positive real number. In the spatial numbers the square is always a negative real number. The product of two arbitrary spatial numbers is the sum of a real scalar and a new spatial number that is perpendicular to both factors. The real scalar equals the inner product of the two spatial factors. The new spatial number equals the outer product of the two spatial factors.

Symmetry

The number of mutually independent direction lines in a number system is called the dimension of the number system. The sequencing on a direction line can be done in one direction or in the reverse direction. The direction of the first direction line is arbitrary. Also, the location of point zero is arbitrary. The coordinate system captures these choices.

Stickiness

If space is covered with point-like objects that act as markers of a coordinate system, then the behavior of the combination is determined by the cardinal number of the set of point-like objects. If the set is countable, then the set of point-like objects acts as an ensemble of discrete objects. Every member of the set seems to be surrounded by empty space. However, if the set is no longer countable, then the behavior of the combination of space and point-like objects changes from an ensemble of discrete objects to a coherent sticky medium. It looks as if the combination occupies all available space. The combination becomes deformable and mathematically the medium acts as a differentiable continuum. This switch in behavior happens if number systems containing all integer numbers and all rational numbers are suddenly extended by adding all irrational numbers. It means that the coordinates besides concerning integer markers and rational markers also concern irrational markers. The coordinate system puts the numbers in the correct sequence. It means that some coordinate markers merge into the same point. All converging series of markers end in a limit that is also a coordinate marker.

Multidimensional arithmetic

For multidimensional numbers, we will use boldface to indicate the spatial part and we will indicate the real part with suffix $_r$.

Thus, the number a will be represented by the sum $a=a_r+\mathbf{a}$. This means that the product $c=a\,b$ of two numbers a and b will split into several terms

$$c = c_r+\mathbf{c} = a\,b = (a_r+\mathbf{a})\,(b_r+\mathbf{b}) = a_r\,b_r + a_r\,\mathbf{b} + \mathbf{a}\,b_r + \mathbf{a}\,\mathbf{b}$$

The product d of two spatial numbers **a** and **b** results in a real scalar part d_r and a new spatial part **d**

$$d = d_r+\mathbf{d} = \mathbf{a}\,\mathbf{b}$$

$d_r = -\langle\mathbf{a},\mathbf{b}\rangle$ is the inner product of **a** and **b**

$\mathbf{d} = \mathbf{a} \times \mathbf{b}$ is the outer product of **a** and **b**

The spatial vector **d** is independent of **a** and independent of **b**. This means that $\langle\mathbf{a},\mathbf{d}\rangle=0$, and $\langle\mathbf{b},\mathbf{d}\rangle=0$

For the inner product and the norm, $\|\mathbf{a}\|$ holds $\langle\mathbf{a},\mathbf{a}\rangle = \|\mathbf{a}\|^2$

Only three mutually independent spatial number parts can be involved in the outer product.

These formulas still do not determine the sign of the outer product. Apart from that sign, the outer product is fixed.

The product of multidimensional numbers will split into five terms.

$$c = c_r + \mathbf{c} = a\,b \equiv (a_r + \mathbf{a})\,(b_r + \mathbf{b}) = a_r\,b_r - \langle\mathbf{a},\mathbf{b}\rangle + \mathbf{a}\,b_r + a_r\,\mathbf{b} \pm \mathbf{a}\times\mathbf{b}$$

Before these formulas are used, the sign of the outer product must be selected.

Sticky coordinates

The set of the complex numbers covers two dimensions. For complex numbers the the outer product does not exist. Two extra independent lines can offer a location to other roots of negative numbers. Together the four direction lines constitute the number system of the quaternions. Both the complex numbers and the quaternions contain a one-dimensional subspace that obeys the arithmetic of the real numbers. In the real number system, all squares of numbers deliver a positive scalar. In the spatial dimensions of the number system all squares of numbers deliver a negative real number. If the real numbers are interpreted as timestamps, then stickiness can be interpreted as a dynamic behavior that covers all spatial dimensions. The stickiness of the medium leads to a particular dynamic behavior of the medium. Any sudden local deformation is quickly spread in all directions over the full medium until the disturbance reaches infinity. Finally, each sudden local deformation expands the medium. The deformations do not touch the number systems. Instead, In the maiden state the coordinate system reflects the geometric symmetry and the geometric center of the number system. The coordinate markers will be used to follow the deformations and the vibrations of the medium. In the maiden state the coordinate markers locate at the same locations as the corresponding numbers. The relation between number system and coordinate system corresponds to the relation between a parameter space and the function that applies the parameter space.

Humans often have problems to comprehend what an infinite set is and are not familiar with uncountable sets. That is why the switch in behavior works counterintuitive.

Functions can describe the deformations and vibrations of the sticky medium. Differential calculus describes the corresponding change of the coordinate markers In fine detail. Mathematicians can interpret the solutions of quaternionic differential equations. Second-order partial differential equations treat the interaction between sticky mediums and point-like actuators.

Combining influences

The sticky medium transfers information between events and observers of that event. Observers can perceive the event via interaction with the sticky medium. The transfer of the information occurs with finite speed. This fact affects the perceived information. If the speed of information transfer is fixed, then a hyperbolic transformation can mathematically describe the involved coordinate transformation. The observer will perceive in spacetime coordinates. Provided that nothing deforms the information transfer path, a hyperbolic Lorentz transform describes the conversion from Cartesian coordinates to spacetime coordinates. Coordinates can describe the dynamic deformations but do not represent coordinate transforms that account for the effects of information transfer through the sticky medium.

Tensors can combine the coordinate transforms and the influence of deformations. The gravitation field describes the sticky medium. Tensors do not work correctly when multiple fields affect the observer. This occurs when both the gravitation field and electric fields affect the observer. First the origin of gravitation and the origin of electric charge must be cleared. Another disadvantage of tensors is that the tool is so complicated that it obscures more than it elucidates. In many cases the coordinate transformation can be ignored, and the application of untransformed coordinates suffices to describe what the observer perceives.

Viscous behavior

Some scientists use different terms to characterize the behavior of the medium and call it viscous behavior.

See: https://www.gsjournal.net/Science-Journals/Research%20Papers-Unification%20Theories/Download/5296

Aether

The sticky medium cannot move independent of the coordinate system. Until about a century ago another medium was considered that scientists called aether. Aether was independent of a coordinate system.

See: https://en.wikipedia.org/wiki/Aether_theories

Hilbert repository

In a structure that supports both countable sets of point-like objects and uncountable sets of point-like objects, the interaction between discrete points and the sticky medium can be investigated.

All Hilbert spaces own a natural parameter space, which presents the maiden state of the selected coordinate system. This coordinate system determines the geometric symmetry and the geometric center of the Hilbert space.

The Hilbert repository is a system of Hilbert spaces that all share the same underlying vector space. One of them acts as a background platform. Most members of the system are separable quaternionic Hilbert spaces that float with their geometric center over the natural parameter space of the other Hilbert spaces. The background platform owns a non-separable companion Hilbert space that embeds its separable partner. The sharing of the same underlying vector space restricts the type of Hilbert spaces that can join the system. All direction lines of the Cartesian coordinate systems must be parallel to the direction lines of the background platform. Only the order along these axes can be selected freely.

A separable Hilbert space can only support operators that manage countable eigenspaces. A non-separable Hilbert space also offers operators that manage eigenspaces for which the eigenvalues are no longer countable. These eigenspaces contain a sticky medium.

The Hilbert repository is explained in
Preprint The Standard Model of Particle Physics and the Hilbert Repository