Multidimensional Infinitesimal and Universal Space-Time, Motion, and Process

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Classical science [1] based on the real numbers without namely actual infinities and infinitesimals and on at most countable number operations cannot resolve Zeno's arrow flight paradox (5th century BC) on motion impossibility. If time is completely composed of durationless moments (instants of time), then at anyone moment, the arrow cannot move at all because no time elapses. Generally, no process with change and variation would be possible. Point-wise dividing time into such moments rather than intervals and segments is a special case of Zeno's measure paradox (5th century BC) on the impossibility of dividing an object of finite measure $M > 0$ into an infinite set of equal parts of measure m: if $m = 0$, then $M = 0$; if $m > 0$, then $M = +\infty$. The 4-dimensional (4D) space-time needs efficient namely 2D data processing.

Unimathematics [2-5] based on uniphilosophy [2, 6] and metauniphilosophy [2, 7] is perfectly sensitive and exactly namely actually both infinitely and infinitesimally (with conservation law universality) operates, point-wise measures, and summation-wise integrates space, time, etc. Quantisets with element quantities q, uninumbers, also uncountable operations, and uniquantities Q as counting point unimeasures discover actually infinitesimal point measure $Q_n = Q/\Omega^n$ and point-wise space-time nature $\Pi_{j=1}^n| x_j-0.5/\Omega, x_j+0.5/\Omega|$ of namely half-open/closed (this first provides symmetry, simple additivity, and naturalness) point $(_{j=1}^n x_j)$ (in n-dimensional Euclidean space-time R^n) for which $Q(_{j=1}^n x_j) = 1$, $Q_n(_{j=1}^n x_j) = 1/\Omega^n$ using countable cardinality $\omega = Q\{1, 2, ...\}$ and continuum cardinality $\Omega = Q(0, 1] = Q|0, 1| = Q(_{1/2}0 + (0, 1) + _{1/2}1)$. At least continually adding points gives curves, surfaces, and space-time, see Figures 1 and 2:
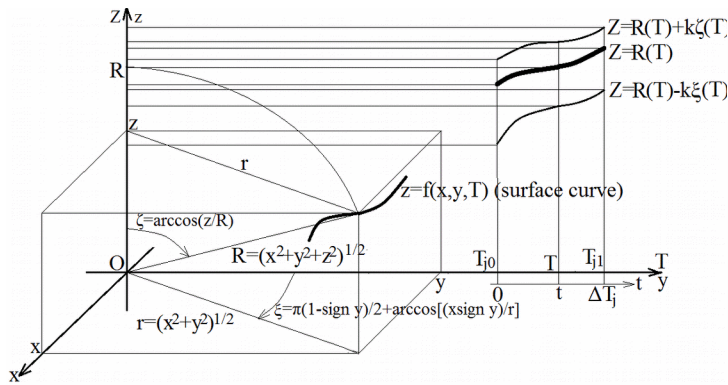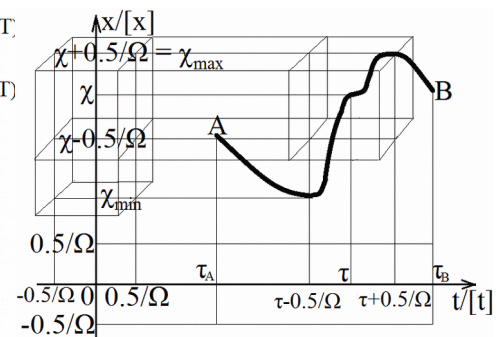

Figure 1. 3D to 1D space, local and unitime

Figure 2. ∞D universal space-time

After preliminarily dividing x_j by their units $[x_j]$, consider x_j to be pure uninumbers. Along with unicoordinate infinity $(-\infty, +\infty) = |-\omega, \omega|$, e.g., the eternity of unitime T, regard local time t, e.g., the lifetime of an object indexed via j in J, moments T and t (Figure 1). See the shown curve composing surface $z = f(x, y, T)$ at this T and 2D representation curves $Z = R(T)$, $Z = R(T) + k\zeta(T)$, $Z = R(T) - k\xi(T)$ using appropriate positive factor k independent of T via the spherical coordinates R, ζ, ξ transformation. Figure 2 shows the 3D projection only of a 4D space-time point. Every space point has at least 3D and a time instant at least 1D infinitesimal nature. Otherwise, by the common 0D point nature, Zeno's paradoxes would be valid with the impossibility of infinite division, motion, and process with change and variation at all. That is why unimathematics is necessary for real world nature understanding. Further precising infinities and infinitesimals additionally to simply ω and Ω via their operations and functions also within this (ω, Ω)-overmathematics in unimathematics, nothing to say about the next infinite cardinal numbers, makes the space-time point nature ∞D.

In unimathematics, resolving Zeno's paradoxes is very simple. Take any time unit [t]. It consists of Ω time instants of [t]/Ω. Let arrow flight duration be t with simply uniform velocity v. Then t consists of t/[t] Ω time instants of duration [t]/Ω. The arrow way is v[t]/Ω during such time instant and v[t]/Ω t/[t] Ω = vt at all, quod erat demonstrandum. Dividing an object of measure M > 0 into ω equal parts gives their measure m = M/ω.

Multidimensional universal actually infinite and infinitesimal space-time discretization, operation, measurement, and integration discovers the nature of space-time, motion, and process and can intelligently solve many types of urgent complicated problems, e.g., model real materials, cracks, and their propagation in aeronautical fatigue.

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