Quantum clock with zero time point

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1 TIME BOUND BY DEFINITIONS
Definitions influence perspectives and mathematics

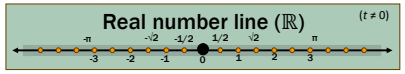
Some key theoretical challenges for quantum clocks:
(1) A point in zero-time, (2) precision, (3) time resolution, and (4) observable time/clock

OBJECTIVE
1. Present the concept of a zero-dimensional point of relational time and how it contrast with modeling real continuous time and linked spacetime.
2. Present 1D time; independent of space, based on finite duration between signals with no dimensional quantity of space or matter.
3. Introduce spatiotemporal operation function (mapping two elements from two sets)

"As far as the laws of mathematics refer to reality, they are not certain, and as far as they are certain, they do not refer to reality." - Albert Einstein

Time as a measure of motion requires key attributes;
- Motion is uniform and continuous; matter is continuous
- If there is no change in motion, there is no time
- Time dilation: Spacetime (light metrics); if there is no change in space, time exist does not exist. Observers measure time differently and gravity has a role.

ABSTRACT CONTINUOUS, INFINITESIMAL TIME MAPPED ON REAL NUMBER LINE



Time as a change in entropy
- Microstate changes, blurred when using continuous change and time[3]

RELATIONAL-TIME[1,2]
Unique from Leibniz's definitions and Newtonian absolute time but all are non-relativistic
- Key similarities…
  - with Newtonian absolute time; constant passage, independent of observer or anything external
  - with Leibniz in that a duration is to time, a network of co-existing timelines
  - time is separate from space
- Different since relational-time...
  - is unique from Newton and Leibniz; an expansion upon ancient civilization methodologies
  - is not *through* 3D Cartesian space, as by definition, 3D space includes space.
  - is measured at one of many privileged points of reference (zero-D point location)
  - is a finite duration between signals, where only past and present discrete signal inputs are used
  - can equal zero, meaning no dimensional time measure between a signal(s) (e.g., superposition)
  - is not continuous infinitesimal time, rather is finite and discrete, applicable to set theory
  - can use recurrent cyclic 1D periods mapped on a linear 1D time index

Privileged point of reference
- Time is uniform at the zero-D point, no dimensional properties at point
- Zero-dimensional Euclidean point, location only (no mass) – similar to a light-cone origin
- Object condition(s) define the point that receives a defined start/stop signal
- Reference point does not move relative to itself by definition; a clock is at a zero-D point.

Signals
- Geometric (centroid) signal from normal matter/particle received at privileged point
- Either aperiodic or periodic; aperiodic is more useful for temporal anchoring in a linear time index
- Discrete relational input; applicable for either discrete or continuous state of matter
- Cyclic signals give recurrent samples periods, or multiple sample periods (frame period)

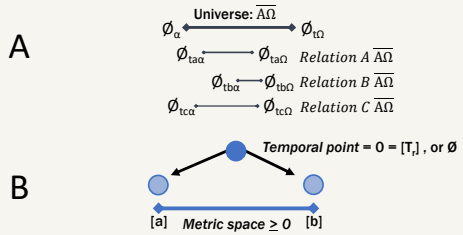
Geometry
- Finite Euclidean 1D duration segment(s), bound by discrete zero-dimensional signals
- Dimensional quantity of time; duration measurable by any universal dimensional unit system
- 1D element defined by set theory
  - Divisions/subdivisions up to a dimensional limit create temporal units, or temporal *rishtars*

Spatiotemporal Operation
- Operation associates an element from a relational spatial set with an element from a relational temporal set, creating a dimensional spatiotemporal element (equation 1), measurable in time and length dimensional units (equations 2, 3). Applicable for modeling motion (Euclidean translation) using time integrals of displacement combined with discrete event simulation methodologies.

2 CONCEPTUAL FRAMEWORK
Discrete event relational durations

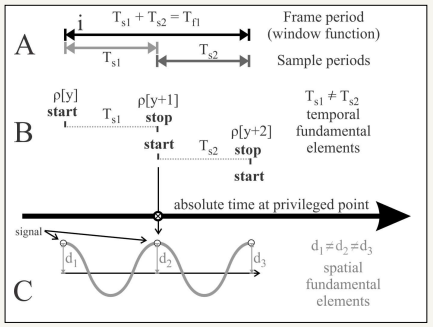
TEMPORAL SPACE[2]
- Network of co-existing timelines, 1D geometric elements amenable to set theory
- Independent of continuous motion; 3D space; and time dilation associated with relativity
- Includes points of zero-dimensional time [t_r = 0], a point element $\emptyset_t$ (time location only)
  - Consistent with Planck time, superposition, and Mohist atomic geometric point
- 1D temporal elements bound by physical limits of our dimensional reality, temporal nodes shared across timelines [object-relative set(s)] with no element of time

Figure 1: Co-existing timelines and zero-D relational time point



(A) Network of four Independent 1D relational-timelines[2] **(B)** Superposition phenomena; particle shares the same instant in time (temporal zero-dimensional point) but can have different spatial relation possibilities. Proposed zero-relational point in time, no dimensional time measure between signals.[2]

Figure 2: 1D temporal quantities from aperiodic signals (cyclic sample or frame periods) spanning linear time[1]



(A) Finite sample and frame periods **(B)** Recurrent signals providing recurrent durations that are not equal (aperiodic signals) **(C)** Discrete signal in continuous absolute time at privileged point by definition (e.g. aphelion position).
Modified from Moore JAMP 2023.

$$x \text{ meters} \cdot y \text{ seconds} = [L_r] \rightarrow [T_r] \quad (1)$$
$$x \text{ meters} = [L_r] \rightarrow [\emptyset_t] \quad (2)$$
$$y \text{ seconds} = [\emptyset_t] \rightarrow [T_r] \quad (3)$$

Spatiotemporal mapping function: $[T_r]$ Relational-duration (temporal rishtars). $[L_r]$ Relational extension between two privileged points at zero-D time (no time quantity) (spatial rishtar).

Mapping includes point elements that are a particular object-relative set with no quantities, only location in space or time. A point element in space, $\emptyset_l$, or a point element in time, $\emptyset_t$, both a unique coordinate from an object-relationship but with no dimensional quantity.

3 FINITE 1D RELATIONAL-TIME; DIVISIBLE

Figure 3: Hyperbolic motion in Cartesian space (relativity) Minkowski diagram

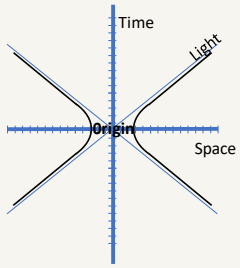
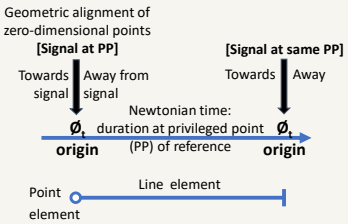
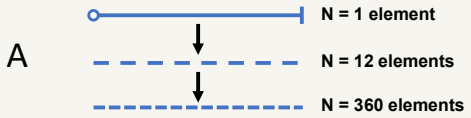


Figure 4: 1D Relational duration at a privileged point[1,2]

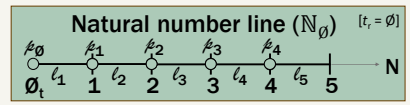


Temporal segment is unique to a relationship, a privilege point, and recurrent signal(s). Measurable by any standard dimensional time unit from the privileged point (PP) of reference

Figure 5: 1D Temporal quantity divided/subdivided into lesser elements (units); class symmetry (D_{12}; time), group order, and numerical position[1,2]



Divisible 1D temporal element into equal uniform quantities of dimensional time that include symmetry, group position, and order. E.g., N = 12(30^1) = 360 temporal unit elements



Relational, Non-abstract discrete, ordered group and numerical position, finite dimensional 1D time units mapped on natural number line

4 CONCLUSIONS

- Relationalism serves as framework to establish a link between zero-dimensional and relational-time, synchronizing points in time using shared signals for two different observers in relativistic spacetime.
- Unifies cyclic and linear timekeeping
- Time progresses in discrete steps at zero-dimensional points, integrating causal signal system principles and discrete event simulations.
- Only the present exists, with the past serving as a progressing memory and the future predicted through causal operations using recorded past events, highlighting cause-and-effect relationships and modeling discrete dynamical systems using discrete event simulations.
- Highlights contrast with relativistic modeling, emphasizing relationalism' s ability to separate space from time, offering a unique perspective on temporal metrics.
- Unique to Newtonian time, introducing multiple privileged reference points and a network of co-existing durations.
- Requires detailed comparison to existing quantum and relativistic time theories.

1. Moore, S.D.P. (2023) *Separating Space and Time for Dimensional Analysis and Euclidean Relational Modeling.* JAMP, 11(9) 2704-2738
2. Moore S.D.P (2024) *Euclidean and Relational Temporal Space.* 12(2) 683-719
3. Rovelli, Carlo, et al. The Order of Time. New York, New York, Riverhead Books, 2018.