Exploring Ultra Lightspeed Communication using Relativistic Non Localization

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Abstract

This paper, the tenth in the series of 'Rudiments of relativity revisited', explores superluminal communication based on relativistic non-localization of new relativity. The new relativity preserves the lightspeed like the current one but also digs deeper into the mechanism behind this constancy. The relativistic non-localization as a superstate is one of the explanations: a photon exists in a superstate of relativistic non-localization, which collapses on detection such that the lightspeed is preserved in the frame of detection. Is it possible to trick this mechanism for the light to supersede its own speed using one or more cross-frame interruptions meant to collapse its superstate in one frame and relaying another burst of light to be detected in another? The two subsequently relayed light-bursts individually preserve lightspeed in their respective frames of detection, but the net result of the two cross-frame flights can be fast or slow travel in vacuum. Various caveats, assumptions, and experiments to explore supra or infra luminal communication under new relativity are discussed.

1. Introduction

Relativistic non-localization (RNL), the mechanism behind lightspeed preservation, is one of the important deduction of the new special relativity (NR) [1,2], along with proposing odd-order warping of space to save the transformed time of the current relativity from being illusory, deeming relativity of simultaneity (RoS) as the undesired effect of assuming localized existence of photons, and accepting the relativity of spatial concurrence (RSC) instead of RoS [1]. Unlike current relativity (CR) that treats moving particles relativistically localized, NR asserts RNL and also hypothesizes it to be the mechanism behind the constancy of lightspeed. Besides, RNL may prove to be an integrating link between relativity and quantum - the two independently proven branches of physics [2]. Current special relativity (CR) [3-7] assumes the particles like photons as relativistically localized i.e. a particle exists at an overlapped position in different frames (OPDF). NR however treats them relativistically non-localized, making them available for detection at different positions in different frames (DPDF) at a given instant [2]. This DPDF part of RNL is quite obvious from NR, but what we require here to achieve superluminal speed is its manipulation. As a mechanism of lightspeed preservation, a moving particle like a photon is said to be in the RNL-superstate until it is detected in any frame. The process of detection results in the collapse of the RNL-state such that the position of its collapse is compatible with the principle of the constancy of lightspeed in the frame of the detector. The motion-state of the detector affects the position of the detection. Thus, both CR and NR preserve the lightspeed, but NR claims to reveal its mechanism as well as stated, whereas CR takes this constancy of lightspeed as a principle. Once NR hypothesizes the mechanism behind the preservation of the lightspeed, there arises a scope of manipulating the same to achieve a net supra or infra lightspeed communication in vacuum by one or more cross-frame interruptions without violating the lightspeed constancy for any individual flight for the frame of detection.

The new transform (NT) of new relativity and the Lorentz transform (LT) both are equivalent, just operating in different domains [2,8], but the NR and CR are not, because CR interprets LT assuming photon's OPDF and RoS [1,9] leaving no scope for superluminal travel. The NR and NT introduce the possibility of supra or infra lightspeed communication (SILC), but the neutral math of LT does not contradict the same if CR's interpretation of LT based on RoS and OPDF that leads to illusory time is discarded.

The setup and techniques of this paper also add to the tests listed in [9-13] which NR and CR can be put to. For all experiments attempting to realize the relativity of spatial concurrence (RSC), RNL, or SILC in this paper or others [9-15], it is desirable to maintain vacuum throughout the photon's flight as the impact air on RNL state is yet unknown.

2. RNL and SILC

LT and NT are summarized below [1].

LT: $x' = \gamma(x - vt)\,, y' = y, z' = z$ (1)

$t' = \gamma(t - vx/c^2)$ (2)

NT:

$x' = em(x - vt)$, $y' = em_{\perp}y$, $z' = e\,m_{\perp}z$ (3)

$t' = e\,t\,,$ (4)

where,

$e = \sqrt{1 - v^2/c^2}$, $m = \frac{1}{1-(v/c^2)(x/t)}$,

$m_{\perp} = em$, $\gamma = 1/e$

And v is the relative velocity between the rest frame (RF) and moving frame (MF) denoted by unprimed and primed variables respectively, c is the lightspeed. At $t=t'=0$, origins of the RF and the MF coincide when two photons are emitted at the common origin, both traveling to the right. We shall restrict here our analysis to first-order approximation i.e. $v<<c$ so that $e=\gamma\sim1$. Fig 1 shows the two frames at a later time t when MF has moved by a distance vt to right and one of the photons is detected at point P in the RF such that,

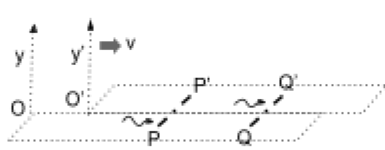

Fig 1. When the photon is detected at P in the rest frame, it is detected not at P' in the moving frame but at Q' that aligns with Q.

$x = OP = ct$ (5)

At this instant where is the other photon in the MF? A believer in CR argues: the twin photon in the RF must also be at P, therefore in the MF to a first-order approximation it must be at point P' overlapped with the point P of the RF, this is also referred to as overlapped position syndrome (OPS). According to NR if a photon is at P in the RF, there is no reason it has to be at P' in the MF. When one of the twin photons is being detected at P in the RF, the other one is available for detection at a very different point Q', aligned with point Q, in the MF. This simultaneous presence of a particle at different positions in different frames (DPDF) is termed as RNL. Using NT and (5),

$x' = O'Q' = ct'$ (6)

showing how NR assisted with RNL preserves the lightspeed in both the frames. A particle retains the RNL state during its flight until the process of detection forces it to collapse to a localized state in the frame of the detector such that the lightspeed is preserved for the frame of detection. RNL spread or the gap between DPDF [2] for the RF observer (RFO), $\Delta X=PQ$, and for the MF observer (MFO) $\Delta X'= Q'P'$,

$\Delta X = PQ = vx/c$ (7)

$\Delta X' = Q'P' = -vx'/c$ (8)

From eq (3) of NT, $x'=ex$ for a photon. To a first-order approximation, we can ignore terms like e or γ,

$|\Delta X'| \sim \Delta X = vx/c$ (9)

Lightspeed is preserved in the frame of detection but for the cross frame observers, photons appear to defy it. The distance of detection of twin photon in the MF for the RFO and the distance of detection of the first photon in the RF from O' for the MFO,

$$X = OQ = x + vx/c \qquad (10)$$
$$X' = O'P' = x' - vx'/c \qquad (11)$$

Eq (10) and (11) are the statements of supra and infra luminal travel (SILT) in vacuum respectively of a photon 'detected in the other frame' (DITOF). This phrase DITOF is a big catch in realizing SILC as a technology. Also, the information or the particle DITOF is of no use unless this information and the benefit of SILT are translated back to the observer's frame. If the observer directly detects the photon in his frame, the benefit of SILT disappears as RNL preserves the lightspeed. Therefore, the key for SILC is to break the travel-path into two flights unevenly, none of which violates the lightspeed limits but the combined journey results in a SILT advantage. Then, there arise other issues of collapsibility, sustainability, stability, viability, and communicability. For the issue of collapsibility, we simply assume discontinuity of RNL-state across flights: the particles do not carry out the information of their earlier RNL-state in the first flight after their short-detection and re-release to their next flight. The other issues in the list shall be addressed while discussing a few schemas for SILT in section 4.

3. Overcoming the fears of ultra lightspeed

Modern physics and the history of its development arouses some genuine concerns and fears of crossing over the limits and sanctity of the lightspeed *c*. The origin of the constancy of lightspeed goes back to Maxwell equations which generate a single constant value *c* for the light to travel in a vacuum. So, light can neither be slowed nor be speeded in the vacuum to travel at a speed other than *c*. Further, taken ahead as a principle by CR, the lightspeed is preserved in all frames irrespective of any relative motion between source and detector. Moreover, a matter particle, with a non-zero rest mass, cannot even achieve *c* because it would require infinite energy to do so when time slows eternally and space contracts abysmally, crunching into a singularity. Moreover, the square root terms in the relativity-transforms generate imaginary numbers for many physical quantities beyond *c*. Therefore, not a real particle having real values but some imaginary tachyon assuming imaginary values can travel beyond lightspeed.

However, fortunately here we are not exploring any matter-particle for the ultra luminal travel but the light itself to defeat the lightspeed in vacuum. But, in NR too, the lightspeed is preserved in the frame of the detection. So, instead of a single flight, it is proposed by using a relay race of photons where the first photon completes its race at the moving detector-generator combo which relays another photon for the second part of the journey completing its journey at the stationary detector in the vicinity of the moving detector. Each photon exhibiting RNL preserves *c* for their respective flights and in their respective frames of detection, but the combination of the two flights is expected to result in SILC by manipulating the same RNL in our favor.

As we have seen, NR and its transforms support the idea of SILT in theory at least, but CR does not. However, it is surprising to note that LT after discarding CR's conventional concepts like RoS, OPDF, illusory time (IT), and self-contradictory moving clock (SCMC) can be interpreted to favor the SILC [4, 10]. Thus, it is only when we combine the concepts of RoS and OPDF with LT, we get a null result,

$$\Delta X' = \Delta X = 0 \qquad (12)$$

as is evident from eq (1) of LT, the point of detection *P'* of a photon in the MF aligns with its point of detection *P* in the RF, yielding, $X = OO' + O'P = vt + (x - vt) = x$ for RFO, and $X' = OP'$ for MFO and hence eq. (12). Thus, Eq. (10) and (12) i.e. the presence of DPDF in case of NR and the absence of DPDF in case of CR makes NR a potential candidate for SILC, and neutral math of LT also does not contradict NR as is also evident from the equivalence of NT and LT [6-9].

Eq. (10) and (11) support both slow and rapid travels of light in vacuum, but the latter sounds more weird owing to the introduction of aforesaid imaginary entities due to square root factors like e or γ. The NR offers two counters for this issue. The particles exist in an RNL superstate before detection and the process of detection collapses the superstate when they realize as localized particles. The lightspeed is preserved in the frame of detection materializing real values of its various physical quantities. For the cross frame, it does not matter whether it traversed as a real or imaginary entity because the process of detection never happened there. The other counter comes from safely interpreting the square root factors like e and γ in special relativity transforms. At c, these factors already reach their extreme effects such as time stopping to eternity, lengths contracting to zero, and energy, mass, or frequency factor spiking to infinity. Going beyond c can not stop the time more than eternity, contract the space beyond a point or take spiking beyond infinity. Whatever drastic has happened at c might remain so beyond c as well, and we know light enters in that drastic regime by moving at c. It does not at least prevent us from realizing infra-luminal travel of light in a vacuum, if not superluminal. We however proceed in line with the former explanation that gives hopes for the possibility to trick around RNL, the very mechanism that preserves the lightspeed in the frame of detection, to achieve SILT both in theory and practice.

4. Setup and conditions for SILT

After addressing fears and concerns, we return where we had left in section 2 wherein we developed the theory of SILT exploiting the RNL of NR. Takeup equation (10), noting that x/c is the time of flight t in the stationary frame, we can calculate an effective apparent velocity of light for the RFO to a first-order approximation to be,

$$c' = X/t = (c + v) \qquad (13)$$

For a positive v, faster and for a negative v slower than lightspeed is achievable if the photon is DITOF. But this advantage is a virtual one because the actual frame of detection does not see this altered lightspeed. Is it possible to pass this information back to the RF without losing this SILT advantage? The strategy here is to divide the total journey of photons into two flights: In the first one, the photon flies from the RF and is detected in the MF, where a relay photon is emitted in the same direction in the second part of the flight to be detected in the RF. The desired SLIT benefit is achieved in the first flight, a part of which is lost in the second one. Therefore, the second flight is kept as small as possible in comparison to the first one to get a net SLIT advantage. See fig. 2, photon burst travels from stationary source (SS) to be detected by a moving detector source (MDS) combination at X_1 distance. In response to the detected initial burst by the leftmost detector-part of the MDS, a new photon burst is generated by its rightmost source-part, say after a response time of t_r which is finally detected by a stationary detector (SD) after traveling a distance X_2.

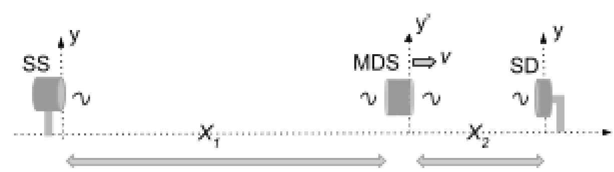

Fig 2. Basic setup for SILT.

The relative velocity between source and detector for the first flight is positive if we assume MDS moving to the right with a velocity v, and the same is negative for the second flight. Therefore, using equation (14), the first flight is traversed with $c+v$ but the second part with c-v, and also the time is lost as the response time of MDS. For a net overall SILT advantage,

$$X_1 \left(\frac{v}{(c+v)}\right) > X_2 \frac{v}{(c-v)} + \frac{c\,t_r}{v} \qquad (14)$$

Thus, X_2 must be kept negligible in comparison to X_1.

4.1 The issue of sustainability: The next issue is sustainability because, in the setup of fig 2, the MDS will soon run over SD for *+v* and over SS for a *-v*. Moreover, the relative distances between SS and MDS and between MDS and SD are constantly changing, which will make the SILC advantages also vary. Therefore, whereas such a system can be used for testing, it is not sustainable. For sustainability, a rotating MDS setup of fig 3 is proposed, where the counterclockwise rotation provides a *+v* and the clockwise one gives a *-v*.

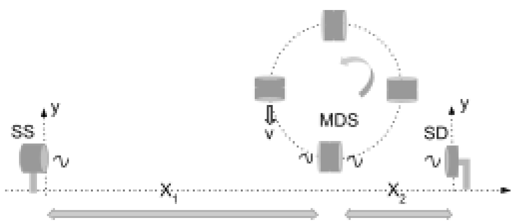

Fig 3. Sustainable SILT setup with rotating MDS

Let the recorded time of travel from SS to SD is t when stationary and T when MDS is rotating. SILT is proven if T is less than or greater than t beyond the experimental errors, where

$$t = (X_1 + X_2)/c + t_r \qquad (15)$$

4.2 Proper collapse of RNL state: One of the most important issues is the proper or total collapse of the RNL-superstate at the MDS so that there is no correlation between the RNL- states of the detected and relayed photons by the MDS. If the RNL state of the detected photons is carried over the MDS to the emitted ones on its right, then the extended RNL state may ensure the lightspeed is preserved for the whole path from SS to SD, and SILT efforts will fail. Thus, MDS need not be viewed just as a moving block working as either a transmitter or a diverter of the photons from SS to SD, but also as a collapser of RNL-state. One design option for MDS can be a fast photodiode (PD) as its front detector which electrically drives a laser diode (LD) or LED as its back source, fig 4. That also makes it tiny so that a lot of MDS units can be packed on the wheel. Lastly, whereas losing the RNL state at the MDS is important, it is also important that photons maintain their RNL state during individual flights. For this, we assume that photons travel through a vacuum during their respective flights as we do not yet know how transmissive or reflective media affects the RNL state of a photon.

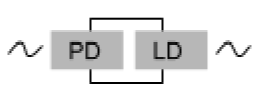

Fig 4. Probable MDS.

4.3 Temporal advantage of SILT

Lastly, let us address how to measure the SILT advantage. As SS and SD lie in the same frame their respective clocks run at the same rate and can be synched. Calculate the overall time that took light to reach from SS to SD, first when MDS is stationary, second when MDS is rotating in one direction and third rotating in another direction. If the time differences for all the three cases are different beyond experimental errors then it establishes the average speed of light from SS to SD is different for all the three cases and SILT is established. Eq. (9) provides an advantage in terms of distance. To a first-order approximation, time differences of the flight from the case when the wheel is stationary can be given as

$$\Delta T = \frac{-v(X_1 - X_2)}{c^2} \qquad (16)$$

where v is positive for counterclockwise, negative for clockwise, and zero for no rotation.

5. Conclusion

Supra or infra lightspeed travel communication is explored here using RNL of new relativity. RNL is the nonlocality across the frames, a bit different from the usual quantum nonlocality within a frame. In NR the lightspeed is preserved in the frame of detection, but collapsing the RNL in one frame before it is detected in the other may trick RNL to achieve SILT. In [9-14] various experiments to distinguish between CR and NR are explored. This paper besides SILT also adds to the list of experiments to test newly revealed tenets like ASW, RSC, and RNL of NR. Besides, this paper also illustrates various precautions, difficulties, and reasons that may adversely affect SILT attempts. The next paper [13] in this series conceives designs of RNL based interferometer and lightspeedometer. Further, the NT gives rise to static field transforms, which in turn may give rise to the possibility of SILT for such fields [15].

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