Gravitational Wave & Relativity Impact Electronic Communication & Engineering

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Abstract. About a few months ago (Feb 11, 2016), the LIGO (Laser Interferometer Gravitational-Wave Observatory) scientist team researchers made an announcement that they had confirmed the gravitational wave already detected on Sept 14, 2015 (by LIGO's twin detectors in Livingston, Louisiana and Hanford, Washington). The wave was predicted by Einstein back in 1916 with his theory of General Relativity. This paper is about gravitational wave and relativity theory that may contribute to the field of Telecommunication and other engineering as well.

1 Introduction

Indirect evidence of Gravitational wave was detected by Hulse and Taylor, they were awarded a Nobel Prize for their work in 1993. The way it was detected was by measuring the timing of radio pulses by Neutron star. They found the orbital period slow down at just the rate predicted by the theory [1]. 2016 is the year of confirming the predicted wave existence. This is an interesting year!

When the x-ray wave was found, nobody knows what to do with it. Later it found it is something to do with medicine world. As the new wave discovered (gravitational wave), again we might ask what to do with this discovery. Whenever they asked the scientist, all answer given probably directly to the goal of science's dream. This is natural for any scientists. If you love science and engineering application, this is perhaps your favorite paper.

2 What is the hope for telecommunication & others?

What analogy of this phenomenon? For Electronics communication's communities, this kind of wave is just like other kind of other wave. It can be produced and detected. For now it is only generated from the sky as nature resource. What happen in this scenario? The answer is the same goes as in electronic communication. Electromagnetic wave transmits and receives. In optic fiber as well: light transmits through fibre optic is then received by phototransistor.

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There is no optical engineering work standalone in this arena; they normally pack together with electronic communication engineering. That makes such Faculty of Communication engineering significant; important key player. The purpose of this paper is also to alert the community of Telecommunication of higher learning; the higher prospect believes to affect the world of communication and other engineering as well.

So what is gravitational wave? It is actually the space-time wave predicted by Einstein in 1916 in General theory of Relativity. For many years, many countries and scientist try to prove the existence of the prediction. Now it is happening to 2016 announcement that the US laboratory (LIGO) confirming the founding (Happened to be about 100 years ago, one decade when once predicted).

The space is proven, that it can be distorted. Right now the highest speed of internet or other communication channel can reach from one point to another point in fiber optic is about almost the speed of C (C is Speed of light). If interconnect with an electronic device, the connection must slower than that. From the engineering viewpoint, we have limitation or constraint of the speed of signal carrier. The speed of signal carrier cannot exceeded the speed of light.

If space-time wave that reached by LIGO about $0.5C$ (theoretically about speed of light; C), therefore this speed of gravitational waves, make it possible for optical information reach will about $1.5C$ (hypothesizes). The maximum speed of light remains C , the only make possible to gain more speed is throughout the 'medium' of 'space wave' speed. This time round regarding telecommunication, the space-time not bending or distort or slowing down but acting as super carrier.

To generate space-time wave is not easy, no technology today can help us, and the natural wave is only hopeful from the sky. However, like the light wave from the sun, we cannot replicate that, unless we know technically about how to produce it from electrical current. Same goes to the space-time generator, for Mechanical Engineering, this kind of challenge will come closer to their community (Since the kind of wave has mass-space-time relationship property).

There might have several kinds of gravitational wave predicted, one that detected by LIGO, it is such like ripples that generated exactly like a mass being dropped in water (Fig. 1(a)). It is like omnidirectional antenna, which transmitting wave in all directions. The characteristic detected by LIGO: low frequency at beginning, the end up with higher frequency with higher amplitude, then settling to rest. The other type perhaps does not come from merging black hole, but might come from single axis, which could come from rotating star too, with steady frequency, which is, more-less like come from a directional antenna transmitter. The illustration of gravitational wave is as in Fig. 1(b).

Fig. 1. (a) Sphere propagation. (b) Monochrome of propagation wave.

It is postulated: (i) light can travel in empty space at the speed of light in all reference frames with the same speed of C , (ii) a wave of space-time in directional wave can bind space-time as a reference frame along with all physic law apply normally in its space-time dimension. If the light is transmitted from one point through the beam of the space-time

wave as directional wave pointed to the second point; predicted the receiver will receive the signal correctly. Therefore, (i) Communication data can be transmitted faster than the speed of light (light speed still constant C in its measurement), (ii) Communication condition (data such as '1' or '0') will remain normal with all physic law, regardless with or without space-time waving as a carrier.

Revising Einstein concept of relativity, which contrast with Newton, gravity, the force is not pulling but 'push' from the effect of bending space-time curvature, therefore any spacecraft, or else will react to the space-time curvature accordingly. Remember, this hypothesis contrast with wormhole, where spacetime is stretch out.

Anything moves along with very strong directional wave propagation perhaps to have properties like a screw like shape, the space curvature will react to it (as bending space-time effect from the Einstein theoretical principle of gravity). In this paper, we think Lorenz transformation (mathematical tool) need to be updated in the version of spiral axis in terms of spacetime relationship.

The problem with the theory of relativity is that, reader tends to get confused on what actually relativity wants to deliver to reader about speed limits. Actually the limitation of speed travel by light is C explained by the theory is the speed of light measured by its own observer (measured in their relative frame only). For an example, you cannot measure two points between wormholes as a distance travel by light (inside wormhole) at outside the wormhole. So light predicted to deliver earlier when it conveys by this sense with its own of space-time behaviour. Any attempt to increase its speed limit measurement beyond C will be governed by this factor, as in Eq.1 below.

$$\frac{u + v}{1 + uv/c^2} \quad (1)$$

The other possibility, which this kind of wave can give its special properties, is that, it can be used to 'hide' the information, unseen by the third party. It can be battle/war secret information, the electromagnetic wave that used to transfer the data perhaps hiding inside the 'shield' wave. Prof Chen was once governed to lead TEKO-100 Gravitational wave detector at UTM around the year 2000's had mention the possibility of future use as new wave technology. As compared to conventional electromagnetic wave/radio, it was well known on how to manipulate the signal. The development of the TEKO-100 in Malaysia was based on support from ISAS (Institute of Space and Astronomical Science), Japan [10].

3 Current issues

To give reader a deep understanding about how speed and time in space-time is really an issue, see the problems that currently influence our own telecommunication system, where it becomes the reality now, which of time dilation really happens in our GPS satellites.

All total 24 GPS satellites that work around the GPS system have to adjust their clock, just to make sure they all remain synchronized relative to each other. The engineering done on that system did adjust their clock, whether relativity has accepted as truth or they still feel skeptical about it. The effect of velocity is represented by the equation Eq.2, and the effect of acceleration/gravity [3], as in the Eq.3 (all variables and constants are in standard form, assume to be known).

$$t' = \frac{t}{\sqrt{1 - v^2/c^2}} \quad (2)$$

$$t' = \frac{t}{\sqrt{1 - 2GM/rc^2}} \quad (3)$$

What is the way to demonstrate on how this situation actually happens? To the extent of convincing, so academicians in the area of field will realize how important it is regarding our satellites or any different gravity or whenever acceleration system take place. There were many experiments already justify the theory [11], for example the time dilation existence when something moving faster relative to another.

Indeed, there is a strong requirement of relativistic coordinate in translating all the problems in the future design. As the current situation, the GPS was designed by Newtonian system coordinate (Euclidean space and absolute time) with post cutting edge technology of relativistic effect adjustment [4].

4 Recommendations

The issue of speed and time of space-time bender is really the issue. Should the relativity study included as a pair to EMT (electromagnetic theory) subject? Especially those in specific program field such as satellite telecommunication system engineering, bachelor or master program or courses. It is clear how electromagnetic become compulsory to electrical bachelors program, and now relativity theory should also be clear as compulsory knowledge to telecommunication engineering bachelor program.

We fully recommend the Special Relativity to be taught and basic of General Relativity is to be understood in related engineering applications but not in detail. The borderline is, is it not so suitable dealing in larger scale of the universe, for example, inside a black hole, expanding of the universe, or some others, unexplained observation. Left side of the Field equation may need adjusting to take account of some of observed problems [8].

Anyway, there are many pros and cons about Einstein's relativity, which never agree at the bottom theory of physic (Quantum Mechanic) for so long. But many experiments done agree with the theory [11], perhaps maybe because of status of race (Jews). Today, the problems of GPS will spread to the user of smart phone worldwide. Soon or later reader will judge fairly when the problem real reach all of us in everyday life.

Here is the example of GPS problems: relativistic effected of velocity; -7microsecond/day, affected by acceleration/gravity give +45microsecond/day, total timing relativistic effect: +38micro second/day, so the GPS system on the satellite has to adjust -38microsecond/day to remain intact synchronous with GPS system on the ground [5]. If the system not corrected in a day of operation, it can give error more than 11km dragging error in the receiver's system [4, 5]. Therefore, because of this clear evidence, it is hard for us to reject the theory of general relativity easily.

The rule of thumb is, Newtonian system and application engineering is the best approximation for on Earth application and when the system is relatively slow. (Whenever Newtonian system move to outer space and with fast system relative to one another, Newtonian seem to have an error clear, for instant the GPS system). While Einsteinian system and application engineering is the best approximation for outer space application and when the system is relatively faster.

For application that need faster communication like precise detection of the event of lighting (anything related to speed of light), it is recommended to have Einsteinian system. For an example to take account of its relativity consideration in its measurement.

5 Conclusions

We hope this delivery of the science application message is successful. In the medium of engineering perspective. Wide opportunity then open by the gravitational wave window.

The new wave application, which probably may enhanced the transmission quality, which may speed up information travel through space or can shield the information of being transmitted. This predictive hypothesis perhaps could come true one day no matter how weird its look like. Even the weirdest thing in mechanic quantum, now turn into public test on quantum computer in 2016! We do not fully understand about mechanic quantum physical phenomenon, but it is work! You can test it online.

Then probably, this will spark the mind of all those academicians in the related area. With GPS have already shown a close relationship between speed, acceleration and time; give all relativistic effect in real action. Real effect. Perhaps they could get involved in this area such as proposing new exciting projects. As well as thinking of some new theories related in the near future.

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