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Wall Street – A Gambler's Paradise; Can Application of Analytical Principles of 'Turbulence' Completely Disrupt Wall-Street Trading?

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Abstract— 'Turbulence' is a commonly used and easily understood English word. It has universal application in all branches of science and engineering and usage in societal dynamics for its advancement. However, its simplicity vanishes when used in Fluid Science and applied particularly to Aerospace Technology (Ref: Shiva Prasad, B. G., 2012). One could broadly define 'turbulence' as fluctuation/s of any dependent parameter/s or variable/s in any system irrespective of its scale (subatomic to cosmic) with respect to its relevant independent variables like space/time. Share price fluctuations seen every day in Wall-Street is a good example of Turbulence (phenomena) signal varying with time.
This paper is meant to demonstrate how the physics of fluid turbulence employing signal processing and statistical analysis could be transplanted to other areas like "Wall-Street" Stock Trading for disrupting High Frequency, Programmed and/or Internet Trading.

Index Terms— Wall-Street, Share Price Fluctuation, Turbulence, High/Low Frequency events, Dominant Low Frequency, Highest Frequency, Inflexion Point, Gradient

1 INTRODUCTION

Turbulence can be described as Commotion, Chaos, Disorder of any system. Some common examples other than 'Wall-Street share price fluctuations' are: waves in ocean, cloud movement seen in the sky, water fountains, chimney plumes (see Shiva Prasad, B. G, 2020), Cigarate smoke, Motion of tree leaves & branches during a gusty wind, motion of any bee or fly, turbulent behavior of any crowd during a game/party, etc. Turbulence can be seen or perceived in very small scales inside solids, liquids and gases (or in general, in matter) as motion of electrons, protons or sub atomic particles, when an atom is unstable or bombarded by other particles. On the other hand Turbulence can be seen or perceived on a cosmic scale in the motion of stars, during birth and death of stars and near black holes.

One can ask the question Why is it Important? The answer is not simple. It depends on the analyst, observer or the user of any system. An engineering analyst could be interested in understanding even the details of the unsteady turbulent structural characteristics [see Simpson, R. L. et al, 1983 {a} & {b}] of the wind flowing over the wing of an airplane, while the designer might be just interested in predicting the gross design parameters like the lift force it can generate to overcome the total weight of the airplane and sustain the airplane in air and the drag it generates for designing the engine for attaining the required speed. A structural designer involved in the design of an overhead, metro rail track for a city would be interested in understanding the wind load including its direction on the structure, both from the point of view of its static and dynamic stability during and after construction and for designing a safe structure. A medical scientist could be interested in researching how blood pressure can affect a human heart although it cannot be measured and used for assessing human health (see Bellur, V. P. & Shiva Prasad B. G., 2020; Shiva Prasad B. G., 2022) An agriculturist could be interested in understanding the turbulent motion of insect swarms; the area covered by a pesticide sprayer which could depend on the turbulent spray characteristics; the effect of the local turbulent environmental, mainly wind conditions on the motion of the drone as well as its secondary effect on the vibratory characteristics of the spray nozzle, all due to the effect of the turbulent environment.

Turbulence is universal & omnipresent over a multitude of spatial & temporal scales in all natural and artificial systems and environment. It is present in all states of matter and can be seen by using the right goggles, (observational tools / measurement sensors & instrumentation) if available. However, in many systems, one can visualize motion of gas, liquid, or solid with the naked eye itself. Hence Turbulence has universal applicability. It is bound by the fundamental laws of physics, namely, conservation of mass, momentum & energy as well as the laws of thermodynamics. However, it evades mathematical solution. Even obtaining a solution using physical modeling amenable to numerical solution, either directly (DNS) or indirectly by employing techniques of modeling fluid physics (Reynolds Averaging/Stress) by simplifying/idealizing the actual fluid system and solving the simplified N.S. equation by introducing artificial viscous damping, diffusion, stabilizing the solution by relaxation, etc. is extremely difficult [Ref: Shiva Prasad, B. G. (2004) and (2012)].

2 WALL STREET ECONOMICS

2.1 Background

Share price fluctuations in Wall-Street stock market are very good examples of turbulent events/phenomenon. Just as in many other cases, such fluctuations cannot be attributed to one or two or even, a few factors. It depends on a multitude of factors. The number of factors/parameters or levers which control a turbulent phenomenon or event cannot be understood in systems involving even nonliving matter, while in living systems it is perhaps more indeterministic. To understand any turbulent phenomenon or in other words the mechanism/s governing such phenomenon, one will have to identify the dominant parameter/s defining/controlling such systems. Hence even on a gross scale (over the complete Wall-Street trading market), correlating the major Wall-Street indices like Dow Jones Industrial Average, Nasdaq, S & P 500, etc. with a few age old dominant factors/parameters like GDP, inflation, interest rate, employment index, etc. tends to become obsolete due to societal change, growth and advancement. One should note here that Turbulence in Wall-street (Wall-Street Dynamics) is influenced by millions of human beings, each one's behavior itself is turbulent and virtually unpredictable! Similarly over a smaller scale, to a lay person, predicting the behavior of any sector or a mutual fund or the share price fluctuation of any particular corporation or industry is extremely difficult due to the number of factors determining such fluctuations. Hence, Wall-street has become a gambler's paradise (Ref: Shiva Prasad, 2012). This is harmful to the society, as unfortunately, the Wall-Street share price variation or growth is normally used to assess the product or service offered by a company, although it need not necessarily have any bearing/correlation with the quality and reliability of the product or service. Thus the society could get misguided by the stock market, share price number of a company.

There is a vast amount of research done by economists, bankers, engineers and other researchers on various aspects of trading markets of the type of Wall-Street, dealing with its good and bad societal features. Danny Busch (2016) has described the organizational, operational and functional details of the European Trading market employing High Frequency, Algorithmic, Programmed as well as Direct Electronic Access and /or Internet trading. He also describes the benefits and problems associated with those types of trading to the society, corporations as well as the traders.

Kirilenko & Kyle, et al. (2017) & Jeff Cox (2014) have given a good analysis and commentary concerning the 2010 "Flash Crash", the impact of speed of execution implemented in any market and the consequential impact of large volume programmed selling to the liquidity of the market and the consequential impact on intraday high frequency and algorithmic traders. They also conclude that although speed of execution increases volatility in a market, it does not impact on longer term traders. Haferkorn (2017) discusses the influence of HFT on the need for high speed in fragmented markets.

Chen, Chen & Valerio (2003) & Obiyathulla, Eskander & Rosli-ly (2008) have discussed the impact of voluntary and mandatory trading halts on information leakage and the consequential effect on price discovery, volume and volatility of the market. Although they have made some specific conclusions relating to specific markets and events, one should note that the market dynamics is in general turbulent and the number of parameters influencing the various market indices could be many and varied and their interaction is also complex for arriving at definitive conclusions.

This paper however, tries to demonstrate how the knowledge of the physics of turbulence using signal processing and statistical analysis techniques could be used to help a Wall-Street trader (gambler?) or a stock or fund manager involved in internet and high frequency / programed trading to make money most of the times at least, and thus disrupt the notion that wall street is a "gambler's paradise". The reason why it can disrupt Wall-Street trading is because, if every trader starts using this technique and is always winning, there will be no losers and stock trading will no longer involve any gambling (guess work or prediction based not only on the value of the product/service of a company but also on several other irrelevant factors/parameters). One can claim that a prudent trader can always win if only he/she understands the market movement and always buys a winning stock. The question being, how does a trader/manager know when to bid on a particular stock and be certain that his/her bid will win? There could be hundreds of parameters or factors causing the share price to vary. This is where application of the knowledge of turbulence, signal processing & analysis or in general – engineering knowledge, could help.

3 STEPS FOR INTELLIGENT INTERNET AND PROGRAMMED TRADING IN WALL STREET

Briefly, the steps needed to be used for placing winning bids almost always (this could depend on the NYSE policies or road blocks) in Internet Trading or which can be implemented in a simple program for application to High Frequency / Programmed Trading is given below with reference to Fig. (1).

Fig. (1) illustrates a typical share price (shown in $ on the Y axis) fluctuation of a stock or mutual fund over one day of trading from 9:00 AM until 4:00 PM (X-axis). It shows the turbulent fluctuation of share price with time of that particular stock or mutual fund. In this example, the clicks or the period (in other words, frequency) used by Wall-street or NYSE for stock /mutual fund share price change is shown as 3 minutes (period of 1 grid on the X-axis). Since the click period is quite large, the stock variation can be joined by straight lines. In case the period is very small, the variation could virtually become a curve. The increase and decrease in share price fluctuations are shown in Fig. (1) in Green and red Color respectively, while blue color represents the period during which time, the share price remains constant.

1) The share price fluctuation frequency (corresponding to the dominant low frequency or large time scale, us-

ing "turbulence" terminology) in the turbulent signal of any stock or mutual fund over a reasonably long period say day, week, month, etc. need to be studied, understood and assessed. The low frequency manner of variation of a stock indicates that it is reasonably stable or steady over a long time period. It could vary by a large extent also depending on the stock characteristics and the time of such observation. On the other hand a stock could vary in a highly turbulent fashion with a high volatility index. The dominant low frequency for a stock is necessary, to assess whether the length of the sample considered for analysis (observation) is sufficient or not. The sample length should include at least a few (say 5 to 10) dominant low frequency events. In the illustration shown in Fig. (1), during the complete one day trading period, one could identify only 2 dominant low frequency events (half cycle is considered as an event) 'CDE' and 'JKLMN'. It is more important to study and assess the small period [i.e., high frequency] events, perhaps in terms of the total number of clicks over which the share price increases (with the rate of variation showing a continuous, positive gradient) as well as that over which it decreases (rate of variation showing a continuous negative gradient). In Fig. (1), the increase and decrease in share price fluctuations are shown in Green and red Color. The highest frequency (or smallest period) decrease happens at 12 Noon (denoted by 'DE') followed by the highest frequency increase (denoted by 'EF') in share price fluctuation. One should note that it need not happen one after the other and also need not be same as shown in this illustration. The low frequency observation period indicates how stable the particular stock's or mutual fund's share price fluctuation is over long observational periods or in other words it is used to confirm that the identified high frequency event is the highest rate at which the stock has varied over the complete observation period. In other words it gives an assurance that the trend of variation of that particular stock has been understood. For understanding a particular stock's variational characteristics, the total length of the observation period could be considerably large, if the dominant low frequency has a very small value (very low frequency), as in the case of a stable stock.

2) For internet trading, one could start when the share price of the stock being traded is increasing and start trading at a frequency much faster (at least 5 times – the higher this number, the better it is) than the observed highest frequency for that stock (considering both increasing and decreasing parts of the signal) and continue to buy until the share price starts (inflexion point) to decrease and then immediately sell all of the money accumulated over a trader's trading session with reference to the particular stock being traded. With reference to Fig. (1), one could start trading at 8 AM at point 'A' and trade at every 0.6 minute interval during the intervals when the share price is increasing only (green parts of the curve) and sell immediately when the share price starts decreasing, as at point 'B'. The buying should again be started around point 'C', when the share price starts to increase and sell all of the accumulated money around point 'D', when it starts to decrease. Likewise, buying should be done in the increasing phases 'EF", 'GH', JK, LM, etc. and selling at the inflexion points F, H, M, etc. until the end of the day. The trading need not be done (can be stopped) during the period, 'KL', when the share price remains constant as although there is no direct loss, there could be an indirect loss if the trader is assessed any fees for each trade.

   One should note that for maximum gain, the buying can be confined to points A, C, E, etc., only (minimum of the green curves, if they can be located with reasonable accuracy) and it is not necessary to spread the buying activity over the complete green part of the curve. However, in the case of highly volatile stock with very high frequency fluctuations, spreading the buying activity over a larger part of the green curve could reduce some risk.

3) In the case of programmed trading, one could write a program to trade at virtually infinite or say 100 or 1000 times faster than the above observed signal's highest frequency. The number of times to be used depends on the Click Frequency (this is an author's terminology for the frequency used by NYSE for changing, or displaying the share price), the speed of the computer and net-work used by the trader, and even the location of the trader's computer. The program could also be written to continuously monitor the gradient (even higher order gradients) and be able to assess the inflexion points (by using extrapolation also) for deciding the buying, selling and stopping of trading activiy.

4) The gradient and higher order gradient computation could perhaps be used to help decide the amount to be traded for optimizing the risk, particularly near the inflexion point. This could also be useful in a highly volatile market with stocks fluctuating in a violent manner. One should always ensure that the buy and sell happens at the right parts and locations of the curve (turbulent signal).

5) On line traders should ensure that they trade only in the green portion of the curve; i. e., buy shares at the beginning of positive gradient (green part) and sell near the end, but before the inflexion point is reached. They should also be able to estimate the highest frequency and submit trades as fast as possible, while ensuring that they remain always in the green part of the curve.
6) In general, the same steps should work for trading when the stock market is closed.
7) This author is not familiar with NYSE's policies concerning its Click frequency, stopping trading (halting) of a particular stock or mutual fund; preventing a legitimate/licensed trader from using certain techniques or programs; limits to the number of trades or 'buy', 'sell' orders per day or per hour; limits in reinvesting (particularly the number of times one can reinvest on a daily or hourly basis); transferring gain/loss to any bank or fund or investment accounts, etc.

This technique could perhaps be applied to all stock/bond, International Currency Exchange and other similar trading markets after obtaining a clear understanding of that particular market's trading policies and practices.

4 CAVEATS

However the author can foresee some of the following possible caveats or road blocks which can be put forth by the NYSE for using this procedure / technique:

1) NYSE could randomly vary the period or frequency of Wall-street clicks. This will not help very much in programmed trading as the trader could perhaps, submit his bids simultaneously to various stocks. Note that the suggested program is likely to compute different high and low frequency time scales for different stocks as each stock's share price fluctuation is likely to show a different turbulent signal pattern or spectrum. Assuming that NYSE has no knowledge of the program the trader is using, NYSE cannot predict the trader's bidding high frequency time scale and defeat the trader by tuning its Wall-street clicks simultaneously for all stocks, bid by the trader. Also, note that the program can be written to submit trades at infinite (very small) intervals.

2) Limiting the total number of trades a person can make in one trading session or per day, even in programmed trading. This could be restricted on a per stock basis or on the complete Wall-street market basis.

3) Limiting the total money a trader can win per day per stock or over the complete wall-street market.

4) Banning the use of a program which always (almost always) makes a winning bid.

5) If just on line trading is done by a group of persons without using the above program but following the above procedure manually, NYSE could perhaps impose restrictions on the number of persons in the group, number of total trades per group and the total amount of money a group can win per session or per day.

6) The speed of acquisition of the required share price and any other information from NYSE, "Flash selling", Hedging, Halting trading, etc., could result in some loss over a short period. However, the net gain should very much overcome this small amount of loss.

The author is not aware of Wall-Street &/or NYSE policies & rules. Irrespectively, he has also identified some road blocks or restrictions which could already be in place or could be introduced. Although the author has suggested some possible ways of overcoming some of those road blocks, one should note that he is not a legal professional and has only given his views as an engineer.

Further, the author likes to clearly indemnify himself from any reader/trader/trading manager using this technique and losing money as this is only based on the author's knowledge and understanding of the topic of "Turbulence" and no reader should hold him responsible for the result they reap in trading in Wall-street or in any other trading market by using these steps.

5 CONCLUSION

This paper draws an analogy between the dynamics of Wall-street trading with the dynamics of turbulent systems. It uses the terminology "gambler's paradise", which becomes relevant only for those who are making (and not losing!) money in wall-street! However, the paper describes a technique of making wall-street a real paradise (after paying attention to the author's disclaimers) for everyone by applying signal processing and analysis techniques used for analyzing turbulent flows/systems. This technique, if allowed to be employed in Internet, High Frequency, or Programmed trading could completely disrupt Wall-street trading/gambling itself for good or bad!

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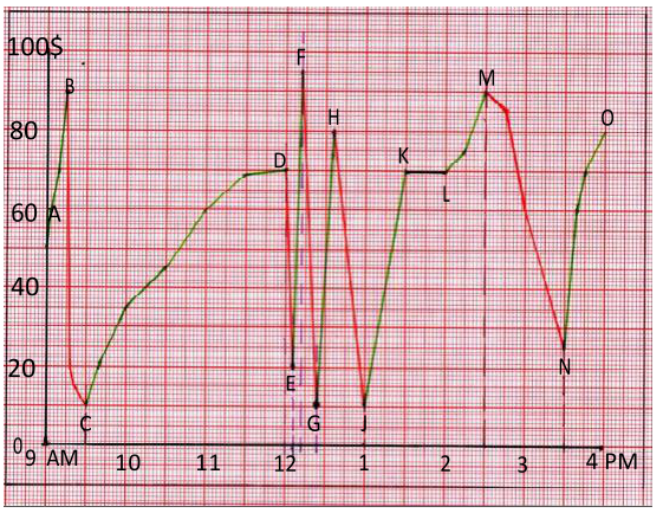

Fig. (1): Typical Turbulent Behavior of the Share Price Fluctuation of a Stock or Mutual Fund