Periodicities in Humankind Dynamics: Influence of Perturbations
(theoretical approach)

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The phenomenon of periodical changes of a lot of humankind manifestations had been established firmly, beginning from O. Spengler, who had attracted the attention to the periodicities of 1000, 300, and 50 years. The last ones had been investigated in details. N. Kondratiev discovered long waves in economy with 50 years period. S. Maslov showed that the dynamics of changes of architectural styles have the same period. V. Petrov, C. Martindale, V. Koshkin with their collaborators demonstrated that 50-year periodicity is manifesting in music and painting styles, in usage of primordial terms in literature texts, in psychological features of societies (preference of extroversive of introversive behavior). V. Petrov showed that the periodicity in culture phenomena is connected with changes in predominance of right and left hemisphere of human brains. The coincidences of periods as well as phases in different countries during the centuries are really impressive (see [1- 3]).

The mathematical model taking into account a competition between numbers of occupation of any (arbitrary, but actual for a given system) of two polar states had been proposed [3]. This model describes the evolution in the case, when system supports (or suppresses) just the rates of success of one of opposite possibilities, leading to changes of form and magnitude of oscillations mentioned. But the strength of a feedback (and thus the period of oscillations) in [3] had been considered unchanged taking in a mind that society preserves main mechanisms of competitive interrelations inside it. What is a reason of this stability? It seems it is the manifestation of very deep mechanism of a feedback determining the basal 50-year oscillations, which is so vigorous, that even strong perturbations cannot destroy it. Maybe the reason is the auto-oscillations or so called limit cycle of a nonlinear system (see [4] for example). The origin of this stability can appear to be the result the A. Chizhevsky's so called "Helios-biological" periodicity [5], determined by the Sun 11-year clock of radiation activity, being so close to the quarter of humanity's period discussed (12.5 years approximately).

We will not explore the origin of this stability, but will use this fact as one which had been established firmly.

The history teaches that political or religion or military or any other large scaled circumstances (like epidemic or mass hunger) are influencing on all states of societies. **But after perturbations the periodicity is restoring. Is there any "afterglow"? Does a future of societies reflect the perturbations of the past times?**

In present research we will suppose the following:

i. Basal differential equations [3], describing the evolution of society's parameters, are preserving (to reflect by any way the oscillation character of a hole process).

ii. Any attenuation or amplification is absent.

iii. Just a strength of feedback (and basic wave length) is changed but: within a restricted term only, with a given magnitude, at a given historical moment of inclusion, related to the phase of natural oscillations.

We are going to understand, what are possible consequences of changes in the main characteristic of societies initiated by interrupt (revolutionary), precisely a change of a basal feedback coefficient in the linear equation proposed in [3], omitting terms responsible on the attenuation $\ddot{x} - ax = 0$, where x designs any property of a system, like economic indices, or measure of introversion (extraversion) of a society, or ratio of primordial expressions to more delicate ones in the literature etc. We modeled the change as a right-angled strobe in the constant of the feedback rigidity a considering the relative changes of the parameter $A = \Delta a / a$. Using this non-dimensional parameter we performed the numerical investigation of its influence on different output characteristics of a system. Let us note that $a = \omega^2$, where ω is the self frequency of a system.

Our goal is to investigate qualitatively (to recognize the tendencies only) what are the influences of this revolutionary perturbation on characteristics of natural oscillations ("humanity curves") after switching the perturbation rectangle strobe off. The parameters of a system which had been researched are as following: the amplitude of the wave W; its frequency $\omega = 2\pi / T_0$; where T_0 is the period of initial (natural) oscillations; T_1 and T_2 are the moments of switching on and switching off of a perturbation, so $\tau = T_1 / T_0$ is the strobe

perturbation relative shift; $\Delta\tau / T_0 = (T_2 - T_1)/T_0$ is the strobe prolongation; $F = \phi / 2\pi$ is the phase shift. All parameters used are dimensionless.

Of course, the initial (natural) frequency is restoring after switching perturbations with any characteristics off. It is the result which had been introduced beforehand: we used the linear model to take into account the universally preserving 50-year period mentioned.

But other properties of "humanity curves" appear to be strongly influenced by a "revolutionary" rectangular impulse. There is the summary of the numerical analysis of influences.

1. Using linear equation of the process, we assumed on a default that the basic frequency is preserved after any perturbations. But nothing had been presumed as to the phase shift after perturbations, appearing to be sensitive to the parameters of last ones. This shift is growing with the increasing of strobe amplitude and is the periodical function of strobe location. The shift changes its sign when the sign of impulse changed under all other parameters of the perturbation preserved. The phase shift after perturbation is the extremely important characteristic of external influences. If these strobes are chaotic in a time, amplitude and sign, one has to expect that the phase shift will not spread the basic periodicity and will not form a non-periodic curve of humanity's behavior.

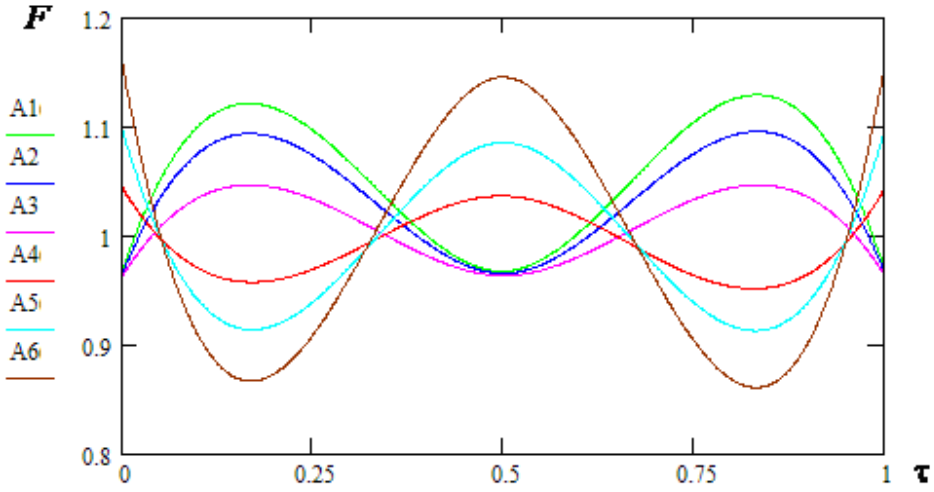

Figure. The dependence of the phase shift F on the relative shift of a strobe τ and relative changes of its amplitude A.
$A1: A = -0.3$; $A2: A = -0.2$; $A3: A = -0.1$; $A4: A = 0.1$; $A5: A = 0.2$; $A6: A = 0.3$.

Thus the question: why the period is stable despite of an influence of perturbations, receives quite verisimilar answer, even inside this simple (linear) model. The matter is that perturbations can possess different characteristics such as moments of start and end, duration, amplitude, the sign of impulse comparing to the current sign of deviations in the basic wave. If perturbations have chaotically changed parameters within the 50-year period, one have to expect chaotic changes of a sign of shifts and thus to expect that phases of the basic waves remain statistically unchanged (see Figure). It is an explanation of the stability of basic period against at least not too long and not too intensive influences.

2. But the perturbations of society's life can be not short-living and not stochastic, but directed. It is the way of governing societies.

The amplitude W of oscillations after strobe switching is changed periodically with the changes of strobe location. The amplitude can decrease or increase dependently mostly of the time T_2 of switching impulse off. The duration as well as strobe amplitude and its sign are influencing as well. The more value of strobe height the more W changes under all other parameters being the same. But just the moment of switching off the "revolutionary" strobe predetermines something like "new starting conditions" in terms of the theory of differential equations. It is not too important what characteristics of an action had been applied: just the moment of stopping is decisive for the future of a system.

What is good and what is harmful for the society's existence?

Is it useful to increase the amplitude of 50-year changes, taking into account that the period cannot be changed? NO! – without doubts. Really, oscillations of economics and people's psychology with too big magnitudes are fraught with a suffering of any population just within a changing the sign of a development. We have "to recommend" for the managements of stable countries to apply some rectangular strobe "intervention" to smooth the amplitude mentioned. A strength, duration and moments of the beginning and the end of an intervention have to be chosen by rules like those mentioned before.

It is of special interest to investigate influences of long-term perturbations like dictatorships for instance. There are many examples of a long governing with the rules, which are not natural. Within these terms the natural feedback had been changed. We will not try to describe what is happened within these terms. But it seems to be verisimilar that such strong impulses appear just at the time when the population is suffering, and any new regime tries to change a present state to improve it (it is only way to be supported by masses). Any dictator regime would like to prolong its existence. So dictatorships will try to exclude the natural order of population's being intending to forbid the natural 50-years oscillations of moods and economy. That is why one has to expect that "inside" the dictatorships' terms the strength of a feedback will be less: it is the terms, when natural competitive behavior of a society is suppressed. The history shows that even long term dictatorships are falling down rapidly or revolutionizing to become the natural order of things. Different countries performed and are performing these transitions. Some of them receive successful "starting conditions" in a new life by the natural society's laws, some begin new life with bad balance… It is extremely important to plan the point of returning from dictatorship to the free society. The careful monitoring of society's life has to be applied to know the moment of influence introduction and to determine the moment of its switching off. The economical state of a country is detected by state establishments. The psychological state of a society has to be determined by sociological services. We would like to emphasize that just empirical aesthetics methods provides possibilities of indirect but informative monitoring of social moods by quantitative research of art creativity [1-3]. It would be somewhat like "applied empirical aesthetics". The aesthetic monitoring of moods of society seems to be effective not only for estimations of historic moment for any impulse to "correct the countries way chosen", but for predicting not so big scaled but also harmful events like terrorist activity, for instance [6]. R. Hogenraad showed the possibility of prediction a beginning of wars using the methods of quantitative aesthetics [7].

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