CHAOS AND ASPIRATION TO REGULATE STRUCTURE, 
AND A METHODICAL ASPECTS OF DYNAMIC MEASUREMENTS FOR TASKS OF CONTROL

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ABSTRACT

This paper have been dedicated to solving questions, which desirable way must be chosen to decrease dynamic errors caused by symbiosis: first of all, of real dynamics of structure, which differs from its complete dynamic characteristics naturally, the second, of dynamic characteristics of measuring channel of control system told from analogous dynamic characteristics got from calibration, and third, of processes dynamics in distributive structure, etc. and also, how we can “improve” of chaotic dynamics of system "process-structure" and stabilize processes. The result of these is minimizing a chaos, stabilizing and regulation of dynamics of structure, and regulating its. Received results convince at such approach.

INTRODUCTION

A great number of “failures” in solving of tasks, when Investigators have been providing dynamic measurements of chaotic processes both in large frequency range and in large strain rate, are stipulated on the ground an information, which was received by measuring channel, and could not reflect real processes (from zone of disturbance too). Therefore, this information often regards as a panacea of measuring task decision in direct sentence. It is considered that if measuring channel corresponds to number of requirement standards that it can be used for measuring tasks with established accuracy. Therefore, in real mechanical system such approach loses sight of number of manifestation. As the rule, real mechanical systems are non-linear systems, and their dynamical characteristics are varied. Convincing arguments are when a real dynamic system gets exited by dynamic influence $a(t)$ with variable amplitude $A_i$ and “fixed” frequency spectra (power spectral density), and/or when disturbances are random or/and chaotic processes.

In said approach problem of control such dynamic system puts forward special requirements to measuring problem, and to information processing, which use for channel of control. How does chaos transform in non-linear (in small) dynamic substructure / subsystem?

This problem has the interest in many real-life developments in industry application.
A versatile symbiosis from:
- “momentary” complete dynamic characteristics of structure;
- dynamic processes having a place in structure (loading-unloading);
- dynamic processes in zone of disturbance;
- transformation of passing medium as of information carrier about structure;
- dynamic characteristics of measuring channel (dynamic characteristics of measuring channel in real life differ from its dynamic characteristics extracted of calibration),

and number of other components are a basic of methodology of construction and decision of measuring problem for task of dynamic control and for concrete class of substructures.

A machining tool is a comparatively acceptable analog, on which worth while to give concrete expression to consideration of problem. As a structure machining tool can have at least one concentrated–distributive element of substructure. And one element of substructure can be an unsteady element in dynamic sentence.

A combination of said requirements corresponds a regarding problem. A common structure of problem (structure and its relationship with other systems) is presented in the Fig.1. Here there are:
as multiple-sources of disturbances from cutting zone is 1; 2 is a non-linear mechanical subsystem; 3 is a chaotic behaviour of subsystem; 4 is an internal dynamics of mechanical subsystem; 5 are sliding surfaces as sources of non-stability of mechanical subsystem; 6 is an unsteady dynamics of subsystem element in cutting process; 7 is an abnormal behaviour of substructure under loading of disturbances; 8 is a medium with non-linear propagation of disturbances; 9 are a measurement transducers; 10 is a targeted measuring channel of measuring system; 11 are signal processing techniques for practical application; 12 is an assessment of resolution and an accuracy in real time (for processes with changing metering error); 13 is a distribution of correlation between real process of “cutting” and chaotic vibration; 14 is a distribution of functions between a measurement transducers and an information processing; 15 is an on-line diagnostic of cutting tool; 16 is an early detection of failure; 17 is a damage identification; 18 is a dynamic signal analyzer; 19 is an in-process optimization of cutting parameters; 20 is a system of control.

A interest excites an abnormal behaviour of substructure (7) in loading under multiple-sources of disturbances (from cutting zone too) (1), which act to non-linear mechanical subsystem (2) with unsteady dynamics (in cutting process) (6). Naturally, subsystem includes sliding surfaces as sources of non-stability of mechanical substructure (5). Disturbances (1) destabilize of internal dynamics of mechanical subsystem (4) calling a chaotic behaviour (3) of subsystems. Elements of structure, which transmit a disturbances (8) have non-linear characteristics too, parameters which change (qualitative changes in system behaviour). It is marked that distribution of functions between measuring transducer (9) as an element of measuring channel (10), and put on of information processing (11) functions must have a place. Such procedures are necessary when measuring transducer can be presented as measuring transducer with concentrated and distributed parameters in the same time. It is impotent when procedures of assessment of resolution accuracy in real-time (12) is not obvious. There are processes with changing metering errors. Measuring procedures include predicting procedures (“weight” relation between processes of normal “cutting” and chaotic vibro-acoustical processes (13)), functions of information processing (11) including of on-line diagnostic of cutting tool condition (15), an early detection of failure of cutting tool (16), of an damage identification (17) procedures.

It is separately marked functions of dynamic signal analysis (18), which can be used in procedures of in-process optimization of parameters of cutting (19). Here all functions, which are foreseen, are lead to.

A described approach improves of quality of machining tool essentially; it permits to decrease of dimension errors, for example, which are conditioned by enumerated dynamic components in its subsystem.

Authors of paper did not set oneself a target to describe each other’s from decisions more detailed. This has view from frames of presented paper-said decision find of application in industry.

**CONCLUSION**

A distribution of functions of information processing between a measuring transformers, and a measuring channel, and signal processing (comparatively quickly and slowly processes in substructure) simplify an approach to control by substructure, in which chaotic processes play of determining role.

A differential and integral information about processes form zone of disturbance (in cutting zone), and their Relationship with dynamics of structure, and an information about added sources of disturbance in structure, and physical and mechanical particularities of medium, with transforms and transmits of disturbance have given of possibility to understand better real dynamic processes. It is a way on the top in understanding that and how are necessary to change in design of substructure in order to exceed results waiting by Users.