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ABSTRACTS OF TECHNICAL SYMPOSIUM PAPERS

Finally data processing by hierarchical data structures as the main factor to support the above-mentioned writing strategies is outlined in this paper.

Kinematics and Electronics of Elastic Systems

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Biography:

Dr. Valeriy Shikhirin aged 52, graduated from Izhevskii Engineering Institute, mathematically specialized group in 1971 and was ordered to Izhevskii Mechanics Plant. He developed systems of technical vision intended for visual control of printed boards' layout and micro assemblies as well as for the control of the equipment for holes drilling, welding, functional test and robotic systems. He defended dissertation in Moscow Aviation and Technology Institute and was moved to the Ministry of Radio Industry of the USSR in the position of the Director of Special Design Bureau (Zelenograd) in 1989. The project was closed by 1990 due to economic crisis in the USSR and He founded scientific-production company GRADERICA, Ltd with the main purpose to extend and advance application of elastic engineering.

Member of the Academy Natural Sciences.

Publications: 1 book, has more than 180 publications including articles, patents, reports at symposiums, conferences, teleconferences, including the international ones (USA, Germany, Canada, South Korea and other).

Abstract

Today "frozen" mechanics of machines and mechanisms of the past centuries can be regarded as a technological "failure" comparing to dramatic break-through of information technologies. As the result, their improvement is achieved only due to new materials and technological processes. And at the same time, their efficiency is growing insignificantly and new functional capabilities rarely appear, in certain technical areas it is not possible at all. Meantime, energy and material cost for developing, manufacturing, utilization and abating them is permanently growing and for the moment there is no solution how to reduce or at least stabilize this growth.

Elastic engineering (ELASTONEERING™) or more definitely *mechanics and electronics of elastic systems* is similar to its natural analog – peristalsis characterized by coordinated, highly efficient action of muscles of digestive organ of a living organism.

This is a new trend in engineering formed at the boundary of mechanics, biology, chemistry and electronics. This section of science dealing with elastic mechanisms and machines fills in the niche between traditional mechanics and bionics based on advanced developments in electronics: controlling, tracing and performing systems, and thin chemical technology: creation of elastic construction materials. They suppose their operation without the presence of a man; transfer of human's activity to restricted areas like space stations, submarines etc; meantime they are meeting new requirements of information technologies.



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Specific properties of elastic mechanics:

- mechanic and electronic system of machine or mechanism is formed as one physical structure performing coordinated functions;
- the core of *ELASTONEERING*™ can be *tore technology* (TORTECH®) based on reversing elastic toroidal shells filled with compressed flowing medium and interacting with central, external and internal peripheral bodies of various shapes and materials, including "smart" sets with preset features; mechanisms converting energy to motion, transfer motions and convert one type of motion to other types are single-mess mechanisms, which perform the same functions as multi-mess mechanisms;
- electronic system of a mechanism ("live layer") is generated in the structure of elastic material of the shell (*elastic integrated and/or functional electronics*) on the basis of technological processes used in microelectronics, clothing, mechanical rubber and other industries;
- machines and mechanisms are capable of self-diagnosis and regeneration end etc.

Physical model of reversing elastic toroidal shell with not less than five degrees of freedom to move over three lines of revolution and around two axes can be demonstrated on a soap bubble. This is a classical physical model allowing the study of properties of gases, liquids and crystals. A soap film formed by ordered arrangement and active material – soap, this combination creates equal stress.

When medium integrity is destroyed there appear new stress centers and simple form becomes compound: two- three- or four fold contiguous elastic spheres associated on a plane. They are coupled like in a dense package when interact in a closed volume.

In order to define stress states, stress concentration areas, expected places of construction break and the areas of possible shell's folding there was used Kassini's "rotation" of plane curves (ovals), which emulates various distorted forms of the shells with simulation of their parameters around lengthwise, crosscut and/or other axes.

Materials:

There were formulated the requirements to elastic construction materials, electronic devices and systems, energy and information main lines.

The most suitable materials available are polymer films with properties and dimensions good for making on their surfaces, for example, dielectric layer as thick as 40...300 μm , $\epsilon \approx 1 \cdot 10^{-4}$; $\epsilon = 3.5$, as well as multiple layers, e.g. metal-dielectric-metal with the properties allowing formation on their surfaces of antenna irradiators of ultrahigh an short frequency band, devices implemented on asymmetric microstrips of ultrahigh an short frequency band, simple ICs with conductors, resistors and low condense capacitors.

The examples of existing elastic machines are soft electric heaters, "smart" clothes, capillary-mercury sensors for defining loading parameters of air casing, ribbon, power and information cables, devices made of conducting rubber.

Application in Electronics:

Creation of elastic machines and mechanisms effects all human activity. In electronics, the key industry defining technological progress, principles of elastic engineering will be developing as:

- more efficient machines and mechanisms comparing to existing handling systems used for transfer of materials in VLCI production, elements of cluster tools (control gates, sealed input/output stations, mechanisms for vertical displacement of carriers, grab vacuum conveyer, vacuum and piston forepumps, medium separator etc.);



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- creation of elastic machines and mechanisms with new performance features and technological processes for their manufacturing;
- creation of new mechanic/ electronic systems, including radio elements etc.

Some results:

A lot of scientific and research works have been carried out.

Manufactured: working models of transportation facilities with enhanced cross – country ability to load/unload and carry heavy and large-size objects; pipeline transportation facilities; containers; lifting and traction facilities; emptiness former; antenna and feeder devices; elements of robots and clusters; laundry washers; systems for fueling and re-fueling of ground – surface, air, subsea and other transport; docking systems, toys; paddy and damping devices as well as percussion devices.

Manufactured and tested pilot models of propulsion device based on conical tore: when pressure of 7000.0 Pa applied to 2 meters tore there is a pulling force of more than 0.5 tons.

