

THE ULTRASOUND CONTROL A DUAL APPROACH – CONCEPTUAL AND TECHNOLOGICAL

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ABSTRACT

The purpose of this paper is to present in a concise manner the passage from a general concept, that of technological development, through a derived concept, that of measuring/controlling to a particular model, that of ultrasound control (technology). Thus, based on the apodictic generalizations from the first chapters of the paper and, after a presentation of the known facts concerning the technology of ultrasound control, presented in the last part, it is possible to suggest, from a systemic approach, the joining of all known elements from this field, into a general measuring chart.

KEYWORDS: Measurement, control technology, ultrasound, defectoscopy , measuring chart.

1. GENERAL REMARKS

In order to make (more and more) possible the organic interaction between science and technology, on the one hand, and the development processes concerning the reality (filed), on the other hand, it is clear that the active/ connoisseur subject (homo faber) is forced to create new tools, methods and technologies with whom to design new structures of reality. These structures, in their turn, once “formatted”, will suggest a change in plan of the global understanding (and approach) of phenomena, from a holistic point of view. This change, as a consequence, will be able to produce itself and for itself a profound/ paradigmatic mutation in the concepts with which it operates; including (as a superb proof of unconsciousness) from the point of view of the scientific vocabulary.

We will be then justified to look at such an epistemic succession – which we intend to connect with the act of measuring, in this paper – from the point of view of (the development of) the tools, methods and methodologies, in one word – from the perspective of technologies. More precisely, of the technologies of control with unconventional means, generic identified as a maieutics of the dynamic connections/ confrontations between “conventional” and “unconventional”. And, even more precisely, we will concentrate on the (apparently)

passive field of ultrasound application, respectively on ultrasound control, a filed which is both rigorous and exciting because of the above- mentioned dynamism.

2. THE CONCEPT OF TECHNOLOGICAL DEVELOPMENT

Since science represents the most rigorous way that one can use to know (this) world, it must be acknowledged then, that this thing would not be possible without technology, which, in its turn, is the most efficient way of changing (this) world; one’s progress against the other’s is actually one’s progress together with the other’s as a classic expression among others, of the loop reaction system; actually of the tandem episteme- tekne.

Thus, during a technological process, the observation together with the scientific activity performed (for example) on the behavior of materials, machines and procedures/ proceedings can – and it is advisable to – lead to the reduction of the total quantum of energy and materials necessary for achieving the products, to the improvement / miniaturization of the machines and to the improvement of the quality of products, related (possibly) to the shortening of production time; all these transformations being then, in essence, aspects of the technological development. In this situation, the concept of technological development (whose elements are synthetically presented in fig. 1 and where

the development of processing technologies is doubled by the development of the control technologies) will be defined as the ratio between science, as an integral expression of

understanding the phenomenon in itself, and technology, as a direct approach of (the results) knowing the act for itself.

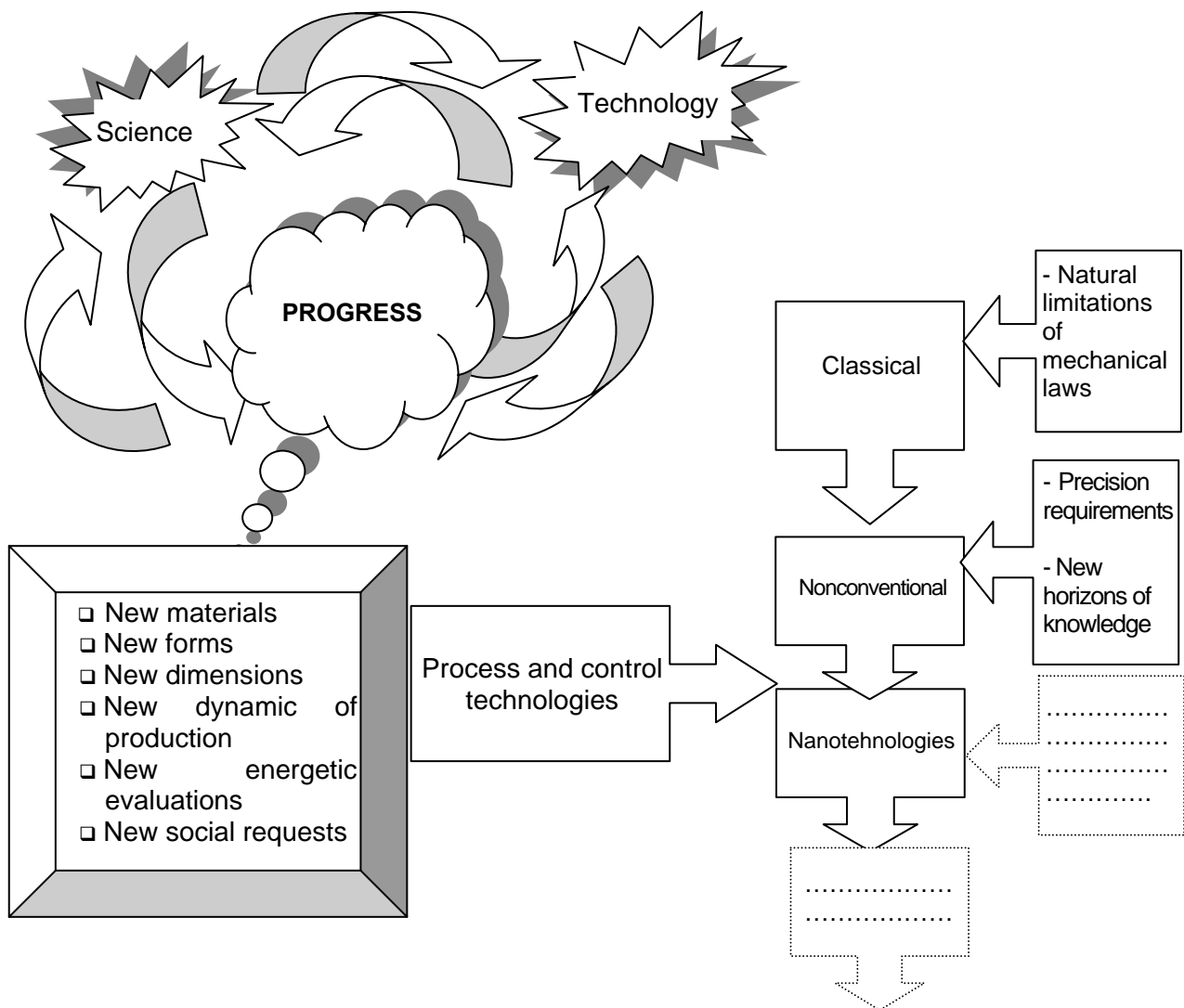


Fig.1

3. THE CONCEPT OF MEASUREMENT

On the other hand, the introduction (in the previous paragraph) of the notion of control makes it absolutely necessary to present the concept of measurement, which, as act, was mentioned in paragraph 1 of the paper. The motivation of such a dual approach is that measuring is, in itself, a self-control (be it even incipient), just as control is, in essence, the checking of measure/ measurement its own measure/ measurement. Though, from

the point of view of the succession/ cycle knowledge/ action/ knowledge, it appears that there is not a more important problem than the one of measurement (and implicitly that of control), since measurement is itself an essential part of knowledge, in the circumstances where, through measurement, we distance ourselves from a complex, confused, sometimes even imperceptible “piece of information”, in order to project it on a (graphic – numeric) chart, without reducing or even altering it. Thanks to this projection,

the piece of information becomes quantifiable. We will then be able to state that the concept of measurement is the ability of the act itself to remove “the measured entity” from its isolated condition, impossible to detect, and to transform it, through knowledge (of the subject) into an open state, equal to the state of knowledge, through which we do not simply reduce the measurement into a simple transformation of the object in figures, but we transform it into a result which can be directly operated on with technological means. The concept is supposed to be valid even if we notice that the results of the measurement are different and the act of measurement will require an (certain) instrument and a (certain) method. The help will (always) come from the field of metrology which will be able to provide us with definite results, away from the human sense perception. Although metrology was seldom contested, with arguments (still) related to:

- the subjectivity of choosing certain means of measurement with different specific features;
- the existence of errors introduced by the means of measurement and its relationship with the object of measurement;
- the inertness of the instrument;
- the influence of the operator.

As a consequence, even if in the field of measurement we do not achieve the absolute, the coincidence or the equivalence between the object and its quantified image, which precedes the transfer and authorizes the reading, as well as the multitude of methods and points of view help eliminate (at least) some particularities concerning one approach or other; and the differences between the obtained results diminish, thus disappearing the variation.

We can then state that, although the critics mainly refer to the distance that remains between the object and the instrument of measurement, this “inadequacy” which limits metrology is also its main impulse: **as, the dimensions and frontiers of reality are pushed further and further away. At the same time with metrology’s advances, becoming more and more refined, the reality which appears to fade away, is revealed at the same time, more complex, putting us in the situation to be confronted with new limitations which,**

once overcome, make us realize that new limitations/ challenges take their place immediately.

As a consequence, we notice that beyond the objections against measurement (metrology), this concept concentrates the substance of everything that saves the phenomena from their isolated character: namely, the capacity, better said the appetite of metrology to permanently renew its own heuristic strategies, in order to obtain performances, such as:

- conquering new, unexplored territories of the reality;
- entering new fields of activity with specific measurement methods: economy, sociology, politics, psychology etc.
- multi parameter complex measurement.

4. ULTRASOUND CONTROL

After the very succinct attempt to create a minimal conceptual frame which comprises/represents the virtual dimension of the concept measurement-control, we will try next to particularize our approach referring to the field of ultrasound control. The main motivation is that, for reasons that are mainly connected to the method, there are general characteristics of the phenomenon, easy to underline and detect, which recommend the usage of ultrasound in the field of control, such as: the wide variety of materials the method can be applied on, or, on the other hand, the simple machinery, easy and relatively accessible, which allows the usage of the method even in building site conditions. A second motivation is that, for reasons we may associate to the presentation, the ultrasound control can relatively easily be extracted from the area of certain solutions that punctually respond to practical requirements and placed into a general measurement chart, able to generically underline the area in which it should operate in order to develop the field.

In fact, if we wish to delimit the area starting from the applications of the ultrasonic waves in the area of control, we will notice that these applications are precisely due to the characteristics of the waves: short wave length, high acceleration of the particles, the possibility of guiding the narrow ultrasonic fascicles towards different places not easily accessible, the possibility of concentrating

and focusing the acoustic energy in a limited space; what is also important to notice is the fact that ultrasound, having a relatively low intensity, cannot produce structural changes, fulfilling only the role of picking up information about the characteristics of the examined object.

And if we want to make an attempt to characterize the field, we will notice that the control technologies, particularly those with ultrasound (but not only) can yield to automation, the process of measurement being performed with microchips, all the more that the result of the control is immediate, since it operates in real time.

Besides all the above stated, we will have to accept that the control operations and the interpretation of results are more complex than the other undisruptive control methods which requires a highly qualified staff, professionally competent and conscientious.

What makes this field extremely interesting is the fact that, through ultrasound control we can particularly check the general chart/scheme of the knowledge we referred to in the first three chapters of this paper. Because, (even) here, in the ultrasound control, certain inherited applications (from a previous paradigm, still functional) considered traditional and (already) representing a “barrier of knowledge”, have all the chances to be/become the infrastructure of some (radical) innovator solutions which, once emerged, will brake the barrier towards a future general integrator theory.

At the end of the paper, in order to systemize the terms referring to the ultrasound control we consider it is necessary to make some succinct remarks about the following key elements:

The functioning principle of the instruments for control and ultrasound measurement is based on the measurement of speed or absorption of ultrasound in different materials.

The means of measurement used for recording the parameters of elastic vibrations and their variations work very fast and have a high power of resolution. They offer the control methods the following advantages: lack of inertness, high sensitivity, high reading precision.

The measurement methods are generally differential methods and compare the

measure subject to measurement with a calibrating device, which ensures a high precision and eliminates the unavoidable errors that appear in the case of the direct method of evaluation of measure (errors that can be caused by the instrument, or temperature etc).

The acoustic measurements can be obtained using impulses and undeadened ultrasonic vibrations. The measurement methods based on impulses are divided into two main categories:

- methods based on measurement of impulse time (echo borehole, leveling instrument etc);
- methods based on measuring the attenuation of own vibrations, stimulated in a certain environment (viscosimeter, internal frictions in metals, plastics, rubber etc).

A second category of measurement is represented by the ones made with vibration, which have two categories, in their turn:

- methods based on progressive waves;
- methods based on stationary waves.

In conclusion, we can state that all the above data, taken one by one, are already known. What has not been done before – as far as we know – is realizing a general frame, a general and generating chart/scheme of the (particular) control charts with ultrasound, endeavor which, once achieved, could confer the study (filed) a certain rigor. This rigor, in its turn could reverberate in the wider filed of control technologies with unconventional devices, and from there, to the even wider filed of nonconventional technologies.

Such an attempt of synthesis is presented in **fig. 2**, where, after presenting the known elements, we propose a general chart of measurement accessible to any potential user which, according to their needs, can choose the structure of the measuring device, the method of measurement or the orientation device – be it the one of the subject or the means of measurement.

Evidently, the contribution itself, as much as it is, does not overthrow (neither does it attempt to) the actual system of values. But it represents a first step which can make the connection between the filed named – out of

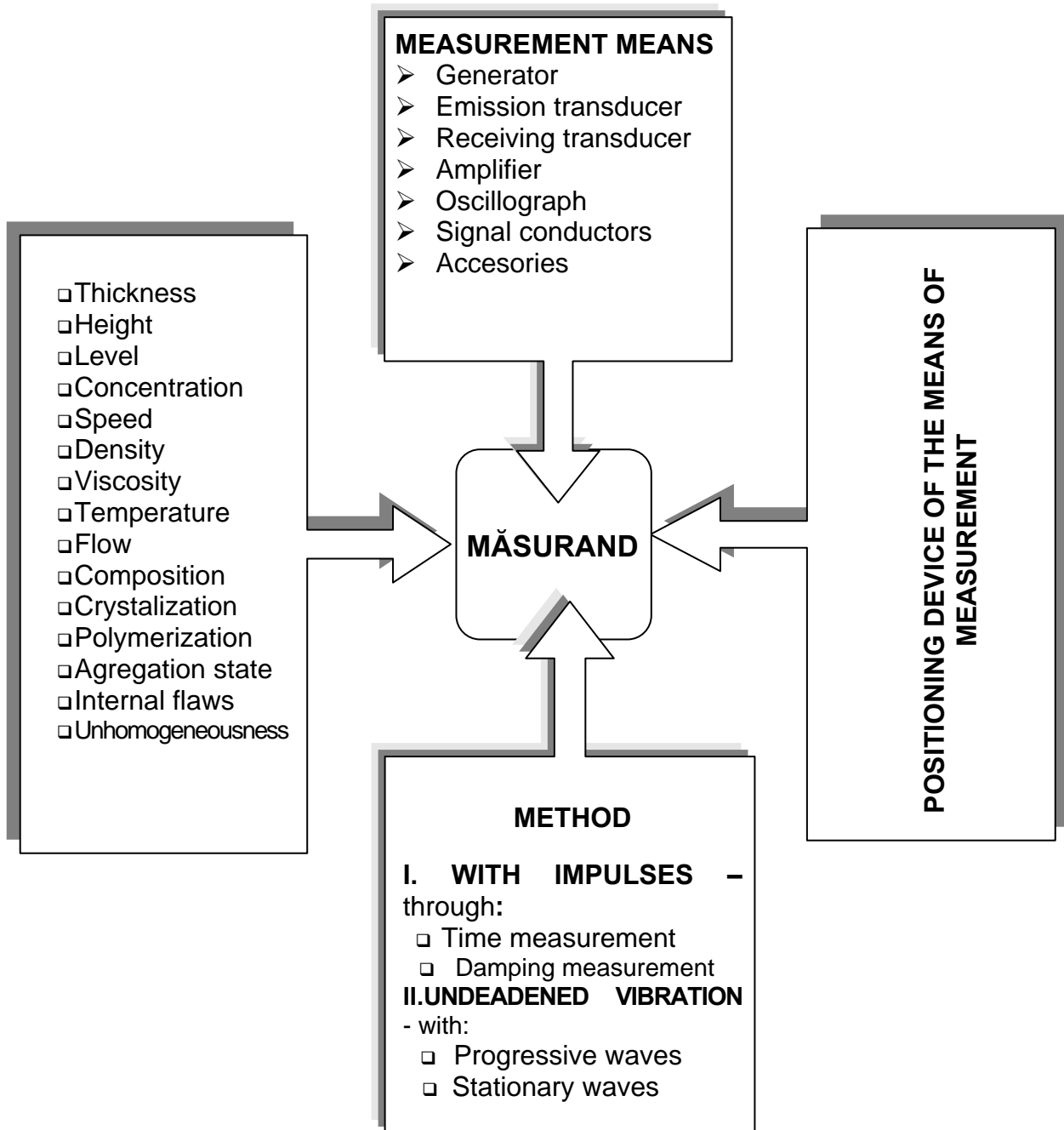


Fig. 2

habit – unconventional and the conventional one and can determine the users to overcome their prejudices, or (why not?) comfort in choosing the method and the device.

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