

A SYSTEMIC MODEL FOR COMPLEX, ELECTRICAL AND ELECTROCHEMICAL EROSION PROCESSING

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ABSTRACT: The complex, electrical and electrochemical erosion processing process is developed within a complex system. This system is made of a series of sub-systems that, through interconnection and interdependence links, make the system functional. This paper analyses the general structure of the system, it establishes the way in which the links between subsystem work and it emphasizes the characteristics of these links.

KEY WORDS: dimensional processing, complex, electrical and electrochemical erosion, technological system, sub-systems, interdependence.

1. GENERAL CONSIDERATIONS REGARDING REAL SYSTEMS

A system is a collection of components and the relations between them, forming an organized whole which brings order in a theoretical field, regulates the material classification in a natural sciences field or makes a practical activity function according to its purpose.

Any system is a component of another larger and more complex system, and it contains at the same time several other systems. A system's environment consists of the collection of elements that do not belong to the system.

The systems composing another *system* are called *sub-systems*. They are in a *subordination* relation to their containing system and have a series of interconnections, interdependences and reciprocal influences to both the containing system and especially its other sub-systems (fig.1).

The components collection gives the system a structure and the interdependences give it functionality.

The following types of connections can appear in such a configuration [4, 6]:

- *interaction*:
 - ✓ between systems;
 - ✓ between a system and another system's sub-systems;
 - ✓ between the sub-systems of different systems.
- *interdependence*:
 - ✓ between a system and its sub-systems;
 - ✓ between the sub-systems of the same system.

These connections can be:

- *oriented* (the *to* and *from* directions are clearly defined):
 - ✓ *inputs* x_i , also called causal quantities;
 - ✓ *outputs* y_i , also called effect quantities.
- *un-oriented* (the direction cannot be defined):
 - ✓ *perturbations* z_i .

The internal transformations determine the outputs and a new system state. In its initial S_i state, a system is characterized by a set of *initial state parameters*. Under the influence of *inputs* and *perturbations* (*influence factors*), through its internal connections (*process parameters*), the system moves to its final S_f state characterized by the *final state parameters*.

The conversion of inputs $X=X(t)$ into outputs $Y=Y(t)$ is done through the transfer function T (eq.1):

$$Y=T X, \quad (1)$$

When there are also perturbations $Z=Z(t)$ that act on the system, the transfer function becomes (eq.2):

$$Y=T (X+Z) \quad (2)$$

Due to the high generality degree it implies, a system can be [6]:

- *abstract* – made of ideas, laws, actions;
- *critical* – it should function at all times at preset parameters;
- *autonomous* – independent or clearly delimited from others;
- *dynamic* – the changes in one part of the system influences the other parts etc.

The connections established at a level system determine their classification according to [4, 6]:

- the existence of system – environment connections:
 - ✓ *open* – it influences/is influenced by other systems and/or the environment through matter and energy exchanges (it has oriented or un-oriented connections);
 - ✓ *closed* – there is only an energy (not also matter) exchange with the environment.
- the complexity degree of the system:
 - ✓ *simple* – it has a few elements and connections between them;
 - ✓ *complex* – it has many elements and connections between them.
- the connection type:
 - ✓ *deterministic* – it has oriented connections;
 - ✓ *stochastic* – it has un-oriented connections.
- the nature of the components:
 - ✓ *concrete* – it has physical elements;
 - ✓ *abstract* – it doesn't contain physical elements (made of ideas, laws, actions).
- the creation method:
 - ✓ *natural* – it exists without human intervention;
 - ✓ *artificial* – it is created by man.

2. THE STRUCTURE OF THE TECHNOLOGICAL SYSTEM FOR COMPLEX, ELECTRICAL AND ELECTROCHEMICAL EROSION PROCESSING (CEEE)

We establish S_{tCEEE} the technological system for complex, electrical and electrochemical erosion processing as the comprising system and S_{stCEEE} as its integrated sub-systems [1, 5]:

- mechanical sub-system $S_{smeCEEE}$;
- electrolyte sub-system $S_{selCEEE}$;
- power supply sub-system $S_{spsCEEE}$;
- command and control sub-system $S_{sccCEEE}$.

Each of these sub-systems is a comprising system for other sub-systems (tab.1).

The mechanical sub-system contains the physical sub-systems which include the work piece and the transfer piece and ensure their movement, positioning and working, so as to obtain their relative position necessary during the process.

The electrolyte sub-system contains all the structures needed to ensure the electrolyte characteristics during the processing as well as its manipulation.

The power supply sub-system contains the structures which ensure the electricity and its characteristics necessary to the processing.

The command and control sub-system contains the structures which correlate the process itself with its initial and final parameters.

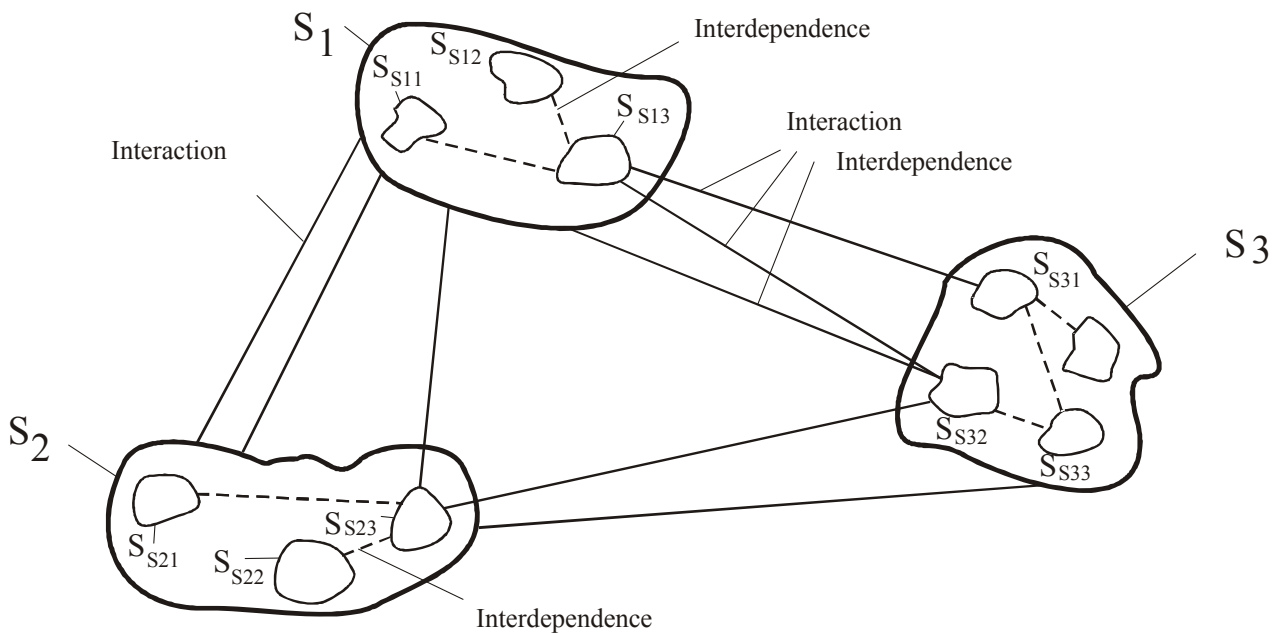


Figure 1. The general structure of systems

3. THE ANALYSIS OF CONNECTIONS INSIDE THE TECHNOLOGICAL SYSTEM DURING COMPLEX, ELECTRICAL AND ELECTROCHEMICAL EROSION PROCESSING

Considering all that was presented in chapters 1 and 2, we analyze the sub-system types and the connections between them.

In table 1, each sub-system is attributed a category to which it belongs.

Depending on the relationship with the environment, the only closed system is the technological system ensemble, while all its sub-systems and their subsystems are open.

The other classification criteria include all sub-system in the same categories:

- complex;
- deterministic;
- concrete;
- artificial.

The technological system during complex, electrical and electrochemical erosion processing represents the comprising system and it sets interdependence connections to its four sub-systems (fig.2). In their turn, these are comprising systems with interdependence connections to their sub-systems.

There are interdependence connections between the four sub-systems of the technological system as well as between the sub-systems comprised by each, as described in figure 2.

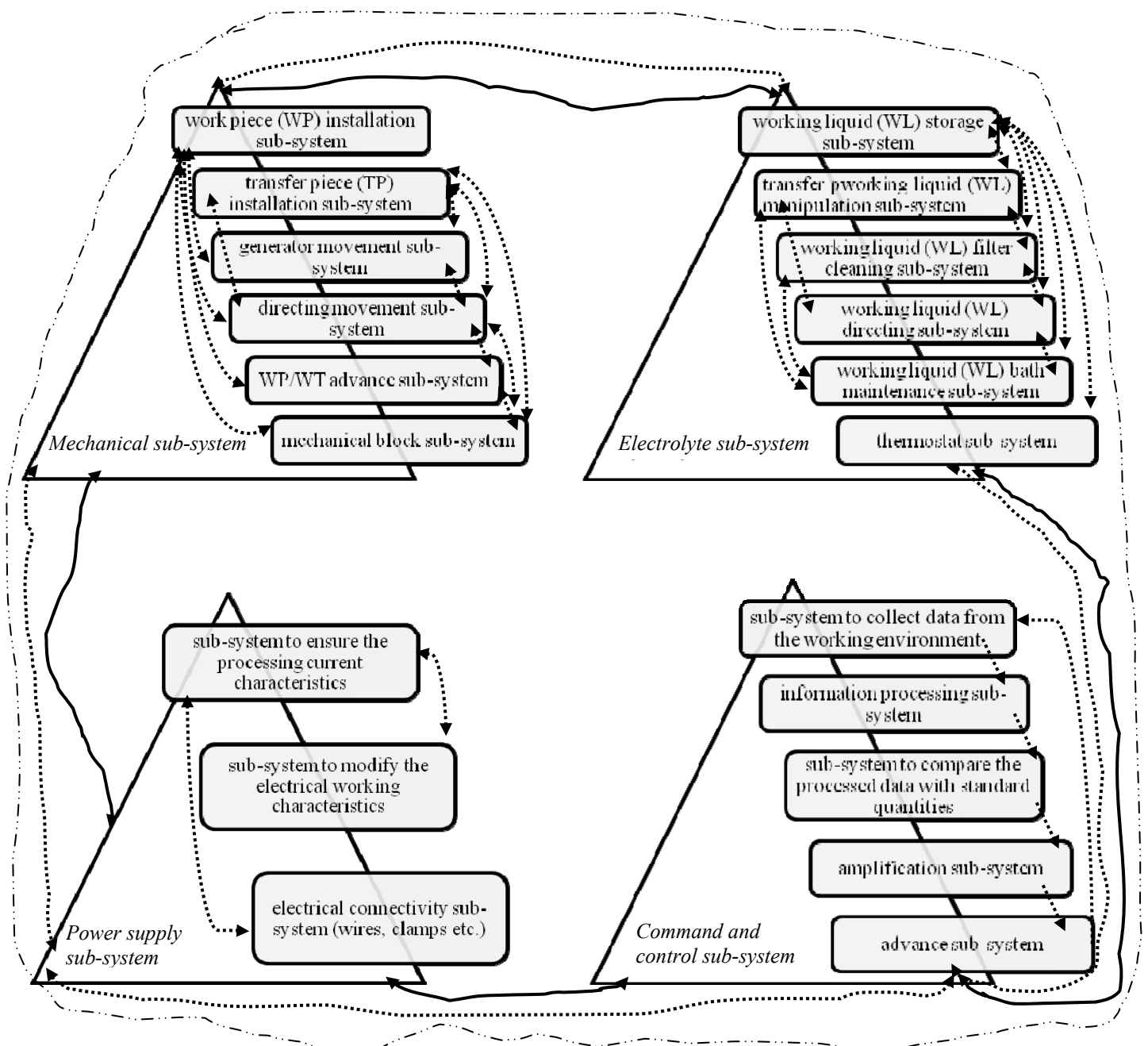


Figure 2. The connections between the technological system sub-system during complex, electrical and electrochemical erosion processing

Table 1. The structure of the technological system S_{iCEEE}

<p>The technological system sub-system during complex, electrical and electrochemical erosion processing S_{iCEEE} closed, complex, deterministic, concrete, artificial system</p>	<p><i>Mechanical sub-system</i> $S_{smeCEEE}$</p> <ul style="list-style-type: none"> open, complex, deterministic, concrete, artificial system 	work piece (WP) installation sub-system	open, complex, deterministic, concrete, artificial system
		transfer piece (TP) installation sub-system	open, complex, deterministic, concrete, artificial system
		generator movement sub-system	open, complex, deterministic, concrete, artificial system
		directing movement sub-system	open, complex, deterministic, concrete, artificial system
		WP/WT advance sub-system	open, complex, deterministic, concrete, artificial system
		mechanical block sub-system	open, complex, deterministic, concrete, artificial system
	<p><i>Electrolyte sub-system</i> $S_{selCEEE}$</p> <ul style="list-style-type: none"> open, complex, deterministic, concrete, artificial system 	working liquid (WL) storage sub-system	open, complex, deterministic, concrete, artificial system
		working liquid (WL) manipulation sub-system	open, complex, deterministic, concrete, artificial system
		working liquid (WL) filter cleaning sub-system	open, complex, deterministic, concrete, artificial system
		working liquid (WL) directing sub-system	open, complex, deterministic, concrete, artificial system
		working liquid (WL) bath maintenance sub-system	open, complex, deterministic, concrete, artificial system
		thermostat sub-system	open, complex, deterministic, concrete, artificial system
	<p><i>Power supply sub-system</i> $S_{spsCEEE}$</p> <ul style="list-style-type: none"> open, complex, deterministic, concrete, artificial system 	sub-system to ensure the processing current characteristics	open, complex, deterministic, concrete, artificial system
		sub-system to modify the electrical working characteristics	open, complex, deterministic, concrete, artificial system
		electrical connectivity sub-system (wires, clamps etc.)	open, complex, deterministic, concrete, artificial system
	<p><i>Command and control sub-system</i> $S_{sccCEEE}$</p> <ul style="list-style-type: none"> open, complex, deterministic, concrete, artificial system 	sub-system to collect data from the working environment	open, complex, deterministic, concrete, artificial system
		information processing sub-system	open, complex, deterministic, concrete, artificial system
		sub-system to compare the processed data with standard quantities	open, complex, deterministic, concrete, artificial system
		amplification sub-system	open, complex, deterministic, concrete, artificial system
		advance sub-system	open, complex, deterministic, concrete, artificial system

Figure 2 also emphasizes the behavior of interactions between the components, the two-way interaction between the $S_{smeCEEE}$, $S_{selCEEE}$, $S_{spsCEEE}$ and $S_{sccCEEE}$ sub-systems.

The following interactions are not shown in order to not overload the figure:

- between each of the $S_{smeCEEE}$, $S_{selCEEE}$, $S_{spsCEEE}$, $S_{sccCEEE}$ sub-systems and sub-system components other than the comprised ones;
- between the sub-systems of the $S_{smeCEEE}$, $S_{selCEEE}$, $S_{spsCEEE}$ and $S_{sccCEEE}$ sub-systems, other than the comprising ones.

4. CONCLUSIONS

By analyzing the technological system during complex, electrical and electrochemical erosion processing (fig.3), the paper establishes a systemic model of this technological process.



Figure 3. Complex erosion equipment

- the multitude of the system/system and sub-system/sub-system connections show that the complex, electrical and electrochemical erosion processing process is governed by a wide array of influence factors and process parameters;
- it is necessary to know these elements in details in order to structure an optimum algorithm for the process development;
- a rigorous process management can ensure the final objective influence factors.

5. REFERENCES

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Four constructive and functional systems and their connections are delimited in the system.

The analysis deepens to set the sub-systems that are comprised by the four systems and their connections, inside the comprising system.

For graphical reasons, to not overload figure 2, the connections between the four sub-systems and the sub-system components other than the comprised ones, as well as between their sub-systems other than the comprising ones, are not shown.

Therefore, a few conclusions can be drawn:

- the paper emphasizes the constructive and functional complexity of the technological system during complex, electrical and electrochemical erosion processing;

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