INFORMATION SOURCES AND THEIR TRUSTWORTHY INFORMATION

Čapek Jan
Ústav systémového inženýrství a informatiky, FES, Univerzita Pardubice

Abstract: *The contribution deals with problem of obtaining trustworthy data from information sources for next processing in the numerous systems. For example decision making systems, warehouses,control systems, etc. Generally we differentiate operating and failure states in a status space of a information sources system. The status space of failure states is divided into safe and, dangerous failure states. Is used majority system of information sources.*
Key words: *information sources system, safe failure state, dangerous failure state, trustworthy information.*

1. INTRODUCTION

A system is a set of members (systems elements), which are bound by some relations between these elements. Each system is defined by its behaviour and structure. The inputs boundary elements of system are for example information sources. The safety system is so safety as safety is each element of this system. The technological leaps of the past decades in computers, electronics, optics, and advanced, high-performance, complex control systems have created the need for extra reliability and safety. An underlying feature of all "safety critical" systems entails a reliable fault-detection (and of ten isolation and reconfiguration) system." Both, the conventional methods of fault detection, such as use of regular limits, trend checks, signal analysis and so on and nowadays applications of the control theory algorithms on modern digital computers and microcomputers supposed using the errorless or trustworthy information's from information sources. (Smutny 1996). For the reason, we focus our future steps into these boundary elements of system – information sources .

2. MODEL OF SAFE SYSTEM

Basically we can divide all systems into two parts. One part should be responsible for data obtaining from the environment (The information sources systems) and the rest of system will be responsible for the controlling, data maintenance or other system activities as reflect the system environment by means of the actuators. (Fig. 1)

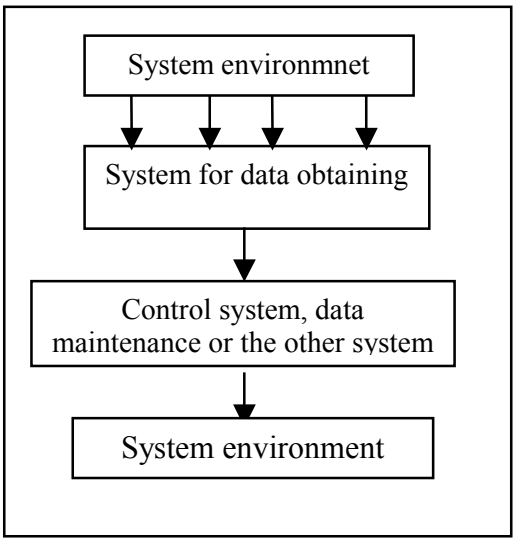

Fig.1. System division into two main parts.

Generally we differentiate operating and failure states in a status space of a system for data obtaining. In a system transition to a failure state the system either remains in this state (it is an absorptive state) or after repair it is in an operating state again. In the case of the safe system for data obtaining, the status space of failure states is divided into safe and, dangerous failure states. After occurrence of the failure state the system has to transit either to a safe failure state (to manage the failure) or after repair it transits to the last regular state.
For our system for data obtaining we can use known quantities from the information theory, such as entropy and mutual information, which enable to establish sufficient number of state variables to describe the behaviour of a given system.

2.1 The system for data obtaining

It is supposed that in the system for data obtaining from Fig.1. is included more information sources then one, all information sources has the same imporances and information content. If we suppose that the probability of the errorless information source's activity has the exponential division we can obtain following table of reliability set of information sources. For example from O'Connor (1988).

Table 1. Reliability set of information source

Number of information sources	Reliability set of information sources
1	0.8000
2	0.9600
3	0.9920
4	0.9984

From the table 1 is clear, that increasing number of information sources sensing the same quantity leads to the increasing reliability set of information sources, but from the certain number of information sources the output reliability increase slowly. If we use two information sources instead of one, the reliability increase, but it is hardly to possible discover which of those information sources has valid information, when one of them has nontrivial error. From this point of view, is clear that the number of information sources must be equal or more than three for possibility of determine not only that all outputs of the information sources are the same, but also determine which element of set of the information sources
has error. (Capek 1994).

2.2 Majority system of the set of information sources.

The simple majority system of n- information sources is shown in the Fig. 2. It is supposed that we use the minimal number of information sources, i.e. the three information sources. Let we denote the output signal from the first information source o_1 , from the second information source o_2 and from the last information source o_3 . The majority of the same output signals from the information sources is supposed be the right value goes from the evaluating algorithm.
Example: Now we suppose that two information sources gives the same right signals. The last information source gives wrong signal. So, if the outputs form the information sources are follows: $o_1 = o_2$ and $o_3 \neq o_1$ is possible suppose that the right value is from the information source N^o 1 and N^o 2.

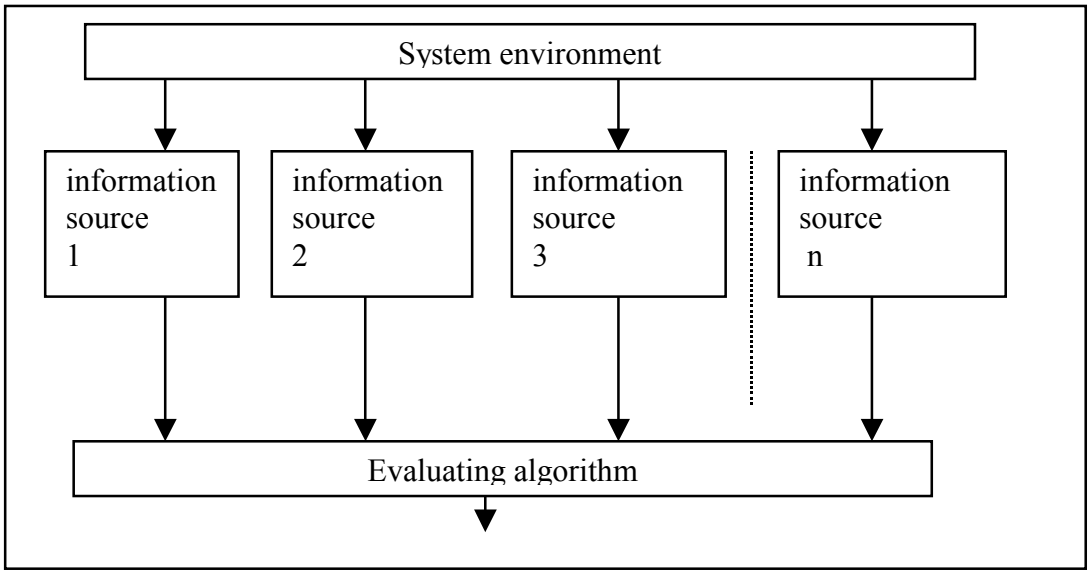

Fig. 2 The simple majority system.

The evaluating algorithm works too simple. The problem gives the nearest output signals i.e. if the all values of signals are different and only one is good. Better results gives following major systems with average evaluation algorithm. (Fig. 3).
If we denote *a* as average of immediate outputs of set of information sources, we obtain:

$$a = \frac{1}{n}\sum_{i=1}^{n} o_i \qquad (1)$$

The wrong information source is recognized from the following differences:

$$\Delta_1 = |o_1 - a|\ ;\ \Delta_2 = |o_2 - a|\ ;\ \ldots.\ \Delta_n = |o_n - a| \qquad (2)$$

Example: Again is supposed that the minimal number of information sources, i.e. the three information sources will be used. If is $\Delta_1 \neq \Delta_2 \neq \Delta_3$ and alongside with this fact is $|\Delta_2 - \Delta_3| = \varphi$, where φ denote permit error, so the information source N^o 1 is faulty and his information is trustless. For the set of information sources we can make such transformation that we try to transform signals from

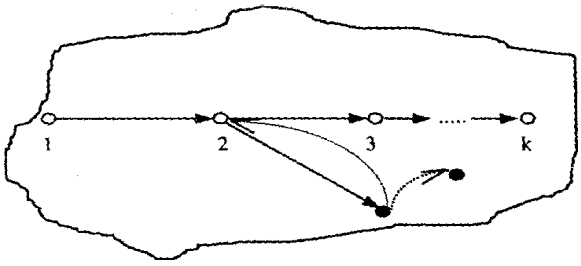

Fig.4 The selection of an appropriate status set of information sources

the information sources into trustworthy information and denoting the possible wrong information source we can transfer the set of information sources into safety systems. (Bariova H., Tomasov,P. 2001) (Fig.4). In the Fig. 4 the dot ● denote dangerous failure state, ○ denote safe failure state (only two information sources are in good conditions, in our, mentioned above, case). The state of information source's system now is changed from the safe failure state (2 information sources are good) into the dangerous failure system. (At least one information source is good). If the information sources system is in the safe failure state or dangerous failure state, is need to replace the malfunctioned information sources and bring the information sources system into the regular state. This replacing procedure has difference in time based on the state of information source's system. If the system has safe failure state the replacing procedure should be as soon as possible, in the other case must be immediately done.

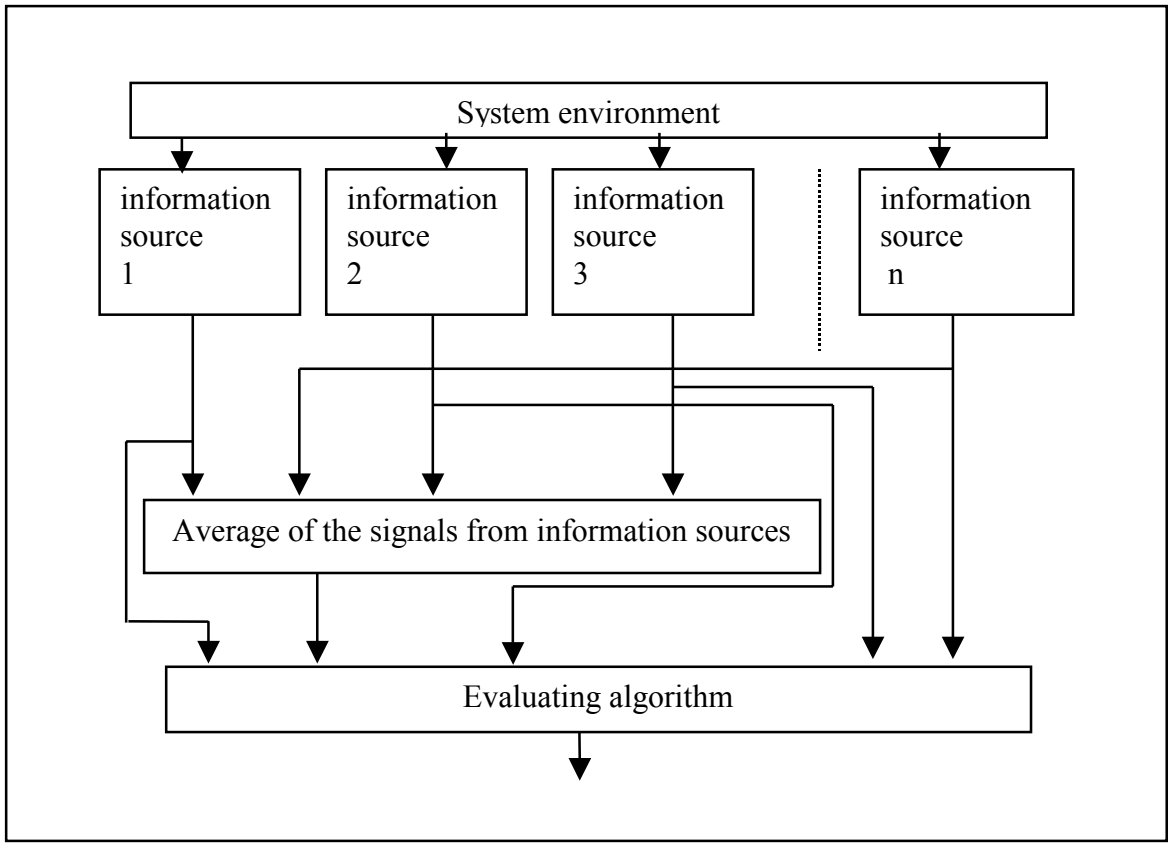

Fig.3 Majority system with average evaluation algorithm

3. CONCLUSION

In the present contribution was shown that problem of obtaining the trustworthy information from the set of information sources is possible solved by majority system with average evaluation algorithm. If we increase number of information sources we can use for the system of information sources following denotation: safe failure state of set of information sources meaning that one of the information sources is faulty and we need exchange it as soon as possible. The second state is dangerous failure state of set of information sources, in system is at least one information source in good condition, but we have not chance to check it, so the information of this set is no trustworthy.

4. REFERENCES

Bariova H., Tomasov,P. (2001). The safe systems identification by Information theory exploitation. TRANSCOM 2001 Zilina Slovakia 2001

Vorisek, J. (1999) Strategic management of Information system and system integration. Management Press 1999 (original in Czech)

Smutny L. (1996) Distributed measurement and control systems with smart information sources and actuators. In. International conference of Process control RIP-1996. Horni Becva

Fabian,P.(1996): Distributed Multimedia Information Processing, V: Studies of the Faculty of Management Science and Informatics, No.5, pp. 10-17, ISBN 80-7100-368-9, Zilina, 1996

Capek J. (1994): Veritable information from the information sources and way of it's obtaining. In. International conference of Process control RIP-1994. Horni Becva (original in Czech).

O'Connor (1988). Reliability Engineering. Hemisphere publishing corp. London 1988

Autor: Assoc.Prof. Jan Capek, Institute of System Engineering and Informatics, Faculty of Economics and Administration, University of Pardubice. Studentska 85, 53210 Pardubice Czech Republic.
E-mail: capek@upce.cz

Recenzoval: Ing. Peter Fabián, CSc., ÚSII, FES, Univerzita Pardubice