

## The Automated Methods of Search of Physical Effects

Sergey A. Fomenkov, Dmitriy M. Korobkin, Sergey G. Kolesnikov,  
Valeriy A. Kamaev and Alla G. Kravets

Volgograd State Technical University, Lenin av. 28, 400005 Volgograd, Russian Federation

---

**Abstract:** Different types of information search in the database, formed on the basis of the proposed models describe physical effects. The examples of requests for information by searching the attributes component input, output, object physical effect (search descriptor A, B, C) and attribute search component search feature “the practical application of physical effect” (search descriptor D, G, H). The technique of formation of additional types of search queries based on consideration of the structural changes of the physical object and effect of the functional dependence of physical quantities of input and output physical effect.

**Key words:** Physical effect, database, descriptor search, full text search, formation

---

### INTRODUCTION

Any kind of a scientific and production activity and also training has information component. Owing to this fact the information search understood as set of the actions, methods and procedures allowing to carry out selection of a certain information from a data file is a component of the solution of any scientific, technical or educational task.

The Physical Effects (PE) are useful when designing essentially new highly effective Technical Systems (TS), developing new technologies, scientific and technical forecasting when training in methods of technical creativity. At the department “Systems of the Automated Design and Search Designing” Volgograd State Technical University are designed a model input and output information of the Physical Effect (the so-called input and output cards PE) (Fomenkov *et al.*, 2004; Kamaev, 2005) as well as the foundation of physical effects.

The proposed models of the description of PE allow to carry out search of PE in various ways (Fomenkov *et al.*, 2004; Kamaev, 2005; Gerasimov *et al.*, 2007; Yarovenko *et al.*, 2013) that increases possibilities of access to the PE array and gives the chance to satisfy a wide range of information requirements of various categories of users.

Now, we will consider in more detail different types of information search in databases on PE.

### MATERIALS AND METHODS

**Search in attributes component of the inputs, outputs, the object of physical effects:** The basis of the search is the

coordinate indexing description of each PE by name (number), the attributes of the input (A), the object (B), output (C). Indexing is carried out by means of the descriptor Information Retrieval Language (IRL 1) containing the following information retrieval thesauruses: dictionary of inputs and outputs PE, PE reference objects. Search can be done by name (number) or any combination of characteristics of input, output, object. In the beginning, we will consider a database of PE formed on the basis of the model description of the PE (Fomenkov *et al.*, 2004; Kamaev, 2005). Classification of possible requests for information to the database for this case is shown in Table 1.

According to the scheme of search besides indexing of descriptions of PE ability to form the Search of Requests Images (SRI), i.e. to index information request of the user means of IRL 1 is required.

We will note the following circumstance. Than the bigger quantity a component A, B, C participates in SRI and than they are more in details described, especially purposefully and narrowly there is a search in the PE array. Therefore if it is required to carry out narrow search (the concrete answer to a specific question) or to narrow search space (in a case when in response to any inquiry there is too many PE), it is necessary to increase in SRI number search a component (in limit option to three) and extent of specification of their description for example, to add qualitative signs and physical quantities at the characteristic of entrance and output influences to increase quantity of signs at the description of object or to use signs at lower levels of hierarchy (instead of “solid body”, “crystalline solid”, instead of “semiconductor”, “the semiconductor with own

Table 1: Information requests to the database of PE

Type of request	The formulation of the task (scientific or technical) solved by means of this request	Examples of formulation of requests
To find PE having the set output	Search of ways of generation of fields (electric, magnetic, gravitational), power influence, streams (substance, heat, microparticles), elastic (sound) waves, electromagnetic radiation, electric current; search of ways (directed) change of physical parameters of any object	How it is possible to create the electromagnetic radiation of a certain (visible, x-ray, radio range waves, etc.)? By means of what effects it is possible to achieve allocation in a macroscopic body of a stream of heat? What means it is possible to cause issue of electrons (ions) from substance? How it is possible to generate highly frequency fluctuations of electric current? How it is possible to increase (to reduce) temperature (volume) of a macroscopic body?
To find PE having the set input	Search of ways of indication, registration, neutralization of the set entrance influences: water, power influence, streams, waves, electromagnetic radiation, current; search of ways of registration of certain physical quantities	What effects can be been the basis for the principle of operation of the sensor of temperature (pressure, activity of oxygen)? How it is possible to control the sound power of ultrasonic waves? What effects are observed in substance at simultaneous action of a magnetic field and gradient of temperature?
To find PE having the set object	The study of the properties of arbitrary objects of certain physical class	What is known of properties of thin monocrystals in the form of a thread or a needle? What physical phenomena are observed on border gas-liquid (liquid-a solid body)? What properties superionic conductors (segnetopoluprovodnik possess, high-temperature superconductors, quantum liquids)?
To find PE having the set object and an output	Search of ways of change of properties (physical parameters) of certain objects; search of ways of generation of certain output influences in the set object; studying of certain properties of objects of a certain class	How it is possible to increase (to reduce) coefficient of diffusion of crystalline solid? How it is possible to influence the elasticity module (strength, a fluidity limit) of metals? How it is possible to change Curie's point of a ferromagnetic (ferroelectric material)? In what ways it is possible to electrify dielectric? In what ways it is possible to deform a solid body? How to create high mechanical pressure in liquid? How to create constant electric field in the semiconductor? What effects are characteristic for electric (optical) properties of liquid crystals?
To find FE having the set input and object	Studying of influence of external and internal impacts on any properties of certain objects; search of ways of registration, indication of physical parameters of certain objects	What effects are observed in solid bodies at simultaneous action of a gradient of temperature and electric field? How does the laser impulse action on the properties of the solid surface? What effect the ultrasound has on heterophase system gas liquid (liquid-a solid body)? What happens to the pyroelectric when heated? What happens when the flow through the superconductor an alternating electric current? How it is possible to control deviation degree from a stekhiometriya in the non-stekhiometricheskikh solid bodies?
To find PE having the set input and output	Search of ways qualitative transformations of entrance influences; quantitative change (change of the direction or value of parameters) entrance influences	How to transform the electromagnetic radiation of visible range to a sound? How to visualize weak acoustic fluctuations? How to transform electric energy (constant electric field) to mechanical energy (deformation of object)? On the basis of what effects there is a reduction of intensity of electromagnetic radiation at its distribution in substance? How it is possible to transform the frequency of electromagnetic radiation?
To find PE having the set input, output and object	Studying of influence of external and internal impacts on certain properties (physical parameters) of certain objects; studying of interdependence of properties (physical parameters) of certain objects	Is it possible to operate by means of electric current plasticity of solid bodies? How high mechanical pressure on electric (thermodynamic, optical) properties of liquid (solid body) influences? What effects describe influence of a magnetic field on mechanical properties of ferromagnetics? Is it possible to change temperature of a solid body by means of a magnetic field? What effects describe communication of mechanical and electric properties in solid bodies? What character temperature dependences of a magnetic susceptibility (electric conductivity) of liquid metals (superionic conductors) have?

conductivity”, etc.). If it is required to expand search space (in a case when in response to any inquiry there is few PE or any), it is necessary to arrive exactly the opposite: to reduce quantity of signs of entrance and output influence to reduce quantity of signs of object or to use signs of higher level of hierarchy (Gerasimov *et al.*, 2007) in a limit case completely to exclude from a search query one or two components (by search in object and an exit to create new SRI on search only in an exit or on search only in object).

For a database on PE created on the basis of the generalized model of the description of PE (Fomenkov *et al.*, 2004; Kamaev, 2005) within the considered method of search additional types of inquiries are possible.

First, when indexing descriptions of PE the four-component structure of  $A \rightarrow B_1 \rightarrow B_2 \rightarrow C$  where by  $B_1, B_2$  an initial and final condition of object B (Fomenkov *et al.*, 2004; Kamaev, 2005; Gerasimov *et al.*, 2007) is used. This structure allows to describe PE with the changing object and to enter the new types of inquiries relating to the  $B_1 \rightarrow B_2$  transformation:

- Search in  $B_1$  into what conditions of  $B_2$  can pass a condition of  $B_1$  what external or internal influences (reasons) cause these transitions to what external or internal influences (consequences) lead these transitions
- Search by  $B_2$  from what conditions of  $B_1$  can be come into  $B_2$  fortune what external or internal influences cause these transitions to what external or internal influences give these transitions
- Search by  $B_1$  and  $B_2$  what external or internal influences cause or have impact on the  $B_1 \rightarrow B_2$  transformation, to what external or internal influences are given by the  $B_1 \rightarrow B_2$  transformation
- Search by A what  $B_1 \rightarrow B_2$  transformations can cause certain external or internal entrance influences
- Search by C from what transformations certain external or internal output influences can result
- Search by A,  $B_1, B_2$  how certain external or internal entrance influences influence the  $B_1 \rightarrow B_2$  transformation
- Search by  $B_1, B_2, C$  what reasons cause certain external or internal output influences upon transition of  $B_1 \rightarrow B_2$
- Search by A,  $B_1, B_2, C$  as certain external or internal influences influence certain properties (physical parameters) characterizing the  $B_1 \rightarrow B_2$  transformation

Secondly, when indexing descriptions of PE the formalized representation of functional communication

between physical quantities of output and input of PE  $y = f(x)$  that also gives additional opportunities for search of PE in nature of change of function  $f$ . When forming SRI in this case signs which hierarchical structure is given in (Fomenkov *et al.*, 2004; Kamaev, 2005; Yarovenko *et al.*, 2013) are used. The combination of signs in a certain sequence allows to formulate request for search of difficult dependence of  $y = f(x)$  for example: to find PE at which at first observed a linear increase in  $y$ , then constancy and further concave increase.

## RESULTS AND DISCUSSION

**Search by attributes component of the search sign “practical application of physical effect”:** Search by attributes a component of input, output, object of PE (A, B, C) in detail considered in 1, allows to realize a wide range of inquiries of the user which main types are presented in Table 1. However, at such method of search it is necessary to index inquiry, i.e. to translate it from a natural language of the user on language, subject to search a component A, B, C (IRL 1) (Korobkin *et al.*, 2013; Korobkin *et al.*, 2013; Fomenkov *et al.*, 2014a, b).

There are also requests that can't be indexed by means of IRL 1. For this purpose the formalized description of a search sign “practical application of PE” is added to model of entrance information of PE (Fomenkov *et al.*, 2004a, b; Kamaev, 2005). The basis of the search index is a description of each attribute PE component D (action), G (object), H (limit) the characteristic “the practical application of PE”. Indexing is carried out by means of the descriptor Information Retrieval Language (IRL 2) containing three information retrieval thesaurus: a handbook of action functions PE, directory objects of action functions PE, reference conditions and restrictions of functions PE. The search can be performed by any combination of components D, G, H.

Examples of formation of SRI means IRL 2 are shown in Table 2. Note that the same search using IRL 1, the greater the number of components D, G, H indicated in SRI and the more they are described in more detail, the more focused and narrow a search in the database PE. Therefore, this method can be repeated search PE recommendations set out in paragraph 2. To narrow the search space is necessary to increase the number of components D, G, H in position, increasing the number of signs in the description of the component or use the features at lower levels of the hierarchy. To expand the search space should do the very opposite.

For indexing a large number of requests can be used both same time search method PE (Components A, B

Table 2: Indexing of information requests to the PE database by means of IRL 2

The formulation of request in natural language	Image search request		
	D	G	H
What are the methods of investigation of the band structure (the Fermi surface) semiconductors?	Research (studying)	Properties of a matter, properties of macroscopic substance, electric, qualitative, electric structure, fermi's surface	Not defined
How it is possible to find radiation defects in solid dielectrics?	Measurement, the direct, Qualitative (indication)	Properties of a matter, properties of a macroscopic matter, the thermodynamic, defects, point, homogeneous (single-phase) body, solid body, dielectric	Not defined
How to increase plasticity of metal alloys when processing by pressure?	Change, increase	Properties of a matter, properties of macroscopic substance, mechanical, deformability, plastic, Homogeneous (single-phase) body, solid body, multicomponent, metal conductor	The presence of impact, force (mechanical) impact Pressure
What methods of management of intensity (color) of electromagnetic radiation exist?	Management	Properties of a matter, properties of a field electromagnetic radiation, quantitative, intensity of the radiation (wavelength)	Not defined
What ways of a data recording exist?	Processing	Information	Not defined
What ways of creation of the superconducting alloys capable exist to maintain big currents and magnetic fields?	Creation	Matter, macroscopic substance, homogeneous (single-phase) body, solid body, multicomponent, superconductor	The presence of impact, magnetic field, electric current

and C components D, G, H), i.e., in this case they are alternatives to each other. Use one of the two methods is determined by convenience particular user solve specific problems. At the same time, there are requests that can be indexed using only one method. Examples of queries which can only be indexed using IRL 2 are shown in Table 2. Examples requests which can only be indexed using IRL 1 requests are of the latter type in Table 1. Thus, in the general case, both the search method complement each PE other.

Note that the search through the PE function which is or can realize these potential PE is widely used in various construction and search techniques inventions. Thus in TRIZ (Altshuller, 2003) established the table applying effects, in which the PE grouped according to their functions. Indexing descriptions PE funds IRL 2 allows you to automate the procedure of creating and expanding the use of such tables PE.

Search of PE by means of the functions which are carried out by them is used and in a technique of profound studying of a design and structure of the Technical System (TS) which is required to be improved (the functional and physical analysis of the TS (Fomenkov *et al.*, 2004; Kamaev, 2005; Yarovenko *et al.*, 2013). This technique provides division of the TS into functional elements and then definition of PE realizing functions of elements. If to enter the description of functions into the functional and physical analysis of the TS means of IRL 2, it will allow to formalize (and respectively, to automate) transition from function to PE.

**Finding:** The methods of search of PE considered above are used in various program complexes realized by us (Fomenkov *et al.*, 2012, 2014a, b; Zaboleeva-Zotova *et al.*, 2013; Korobkin *et al.*, 2014a, b). Besides, researchers on

improvement and creation of new methods of search in the PE database for example use of traditional full text search (Korobkin *et al.*, 2013), search in character and range of change of the physical quantity (Gerasimov *et al.*, 2007; Yarovenko *et al.*, 2013), intellectual search (Fomenkov *et al.*, 2014a, b) and others are conducted.

## CONCLUSION

Thus, we considered different types information search in a database of physical effects. Examples were given of making requests for information under the search descriptor A, B, C (attribute component input, output, object physical effect) and finding D, G, H (attribute component search feature “the practical application of physical effect”). The article also presents the general method of forming additional types of search queries based on consideration of the structural changes of the physical object and effect of the functional dependence of physical quantities of input and output physical effect.

## ACKNOWLEDGEMENTS

The research has been performed with the financial support from the RFBR (project 13-01-00302-a) and the Ministry of Education and Science of the Russian Federation within the frameworks of the project part of the Government statement (project 2.1917.2014/K).

## REFERENCES

- Altshuller, G.S., 2003. To find idea. Introduction to the Theory of the Decision Inventive Task 3rd Prod. Petrozavodsk, Russia, Pages, 240.

- Fomenkov, S.A., D. Korobkin and S. Kolesnikov, 2014a. Method of ontology-based extraction of physical effect description from Russian text. Proceedings of the 11th Joint Conference on Knowledge-Based Software Engineering, September 17-20, 2014, Volgograd, Russia, pp: 321-330.
- Fomenkov, S.A., D.M. Korobkin, S.G. Kolesnikov, A.M. Dvoryankin and V.A. Kamaev, 2014b. Procedure of integration of the systems of representation and application of the structured physical knowledge. *Res. J. Applied Sci.*, 9: 700-703.
- Fomenkov, S.A., D.A. Davydov and V.A. Kamaev, 2004. Modeling and the automated use of the structured physical knowledge. Monograph, Mechanical Engineering, Pages: 278.
- Fomenkov, S.A., D.M. Korobkin and A.M. Dvoryankin, 2012. A program complex of representation and use of the structured physical knowledge. *Messenger Comput. Info. Technol.*, 11: 24-28.
- Gerasimov, A.M., P.A. Kolchin and S.A. Fomenkov, 2007. The automated system of search of physical effects Useful effect. *Software Products and Systems*, No. 4, pp: 1-7.
- Kamaev, V.A., 2005. Conceptual design. Development and Improvement of Methods, Collective Monograph, Mechanical Engineering, Pages: 356.
- Korobkin, D.M., S.A. Fomenkov, S.G. Kolesnikov and V.A. Kamaev, 2014. Synthesis of the physical principle of operation of engineering systems in the software environment CPN tools. *Res. J. Applied Sci.*, 9: 749-752.
- Korobkin, D.M., S.A. Fomenkov, S.G. Kolesnikov and Y.F. Voronin, 2013a. System of physical effects extraction from natural language text in the internet. *World Applied Sci. J. (Inform. Technol. Mod. Ind. Edu. Soc.)*, 24: 55-61.
- Korobkin, D.M., S.A. Fomenkov, S.G. Kolesnikov and Y.A. Orlova, 2013b. A multi-stage algorithm for text documents filtering based on physical knowledge. *World Applied Sci. J. (Inform. Technol. Mod. Ind. Educat. Soc.)*, 24: 91-97.
- Yarovenko, V.A., S.A. Fomenkov and S.G. Kolesnikov, 2013. Computer representation of functional dependence of physical quantities of an entrance and exit of physical effect. *News of the Volgograd State Technical University*, t.17, No. 14, pp: 135-139.
- Zaboleeva-Zotova, A.V., Y.A. Orlova, V.L. Rozaliev, S.A. Fomenkov and A.B. Petrovskij, 2013. Formalization of initial stage of designing multi-component software. Proceedings of the IADIS International Conference Intelligent Systems and Agents, July 23-26, 2013, Prague, Czech Republic, pp: 107-111.