# SIGMA technology

A new optimisation strategy based on the use of IOSO, a new generation optimisation technology

"For since the fabric of the universe is most perfect and the work of a most wise Creator, nothing at all takes place in the universe in which some rule of maximum or minimum does not appear." Leonard EULER

IOSO NM
is the software for multicriteria nonlinear optimization
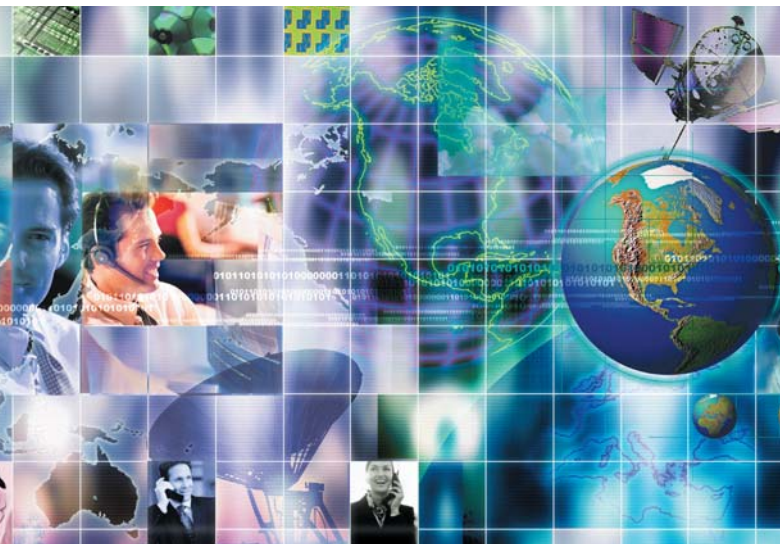
The ideal solution for:

- Improving performance
- Searching for optimal management laws
- Identification and verification
- Cutting costs

IOSO NM is a unique software package opening up new opportunities for the market of "complex" practical problems

It is used to improve the performance of complex systems, technical facilities and technological processes and to develop new materials based on a search for their optimal parameters. The software also enables lower research expenditures and shorter implementation time. The main purpose of the system is to relieve a designer or researcher of the sufficiently complex and very labour-intensive process of searching for optimal system design parameters which simultaneously meet a great number of sometimes controversial requirements.

Purpose

Performance Improvement and Design Optimization

IOSO NM is used to maximise or minimise system or object characteristics which can include the performance or cost of or loads on the object in question. The search for optimal values for object or system characteristics is carried out by means of optimal change to design, geometrical or other parameters of the object.
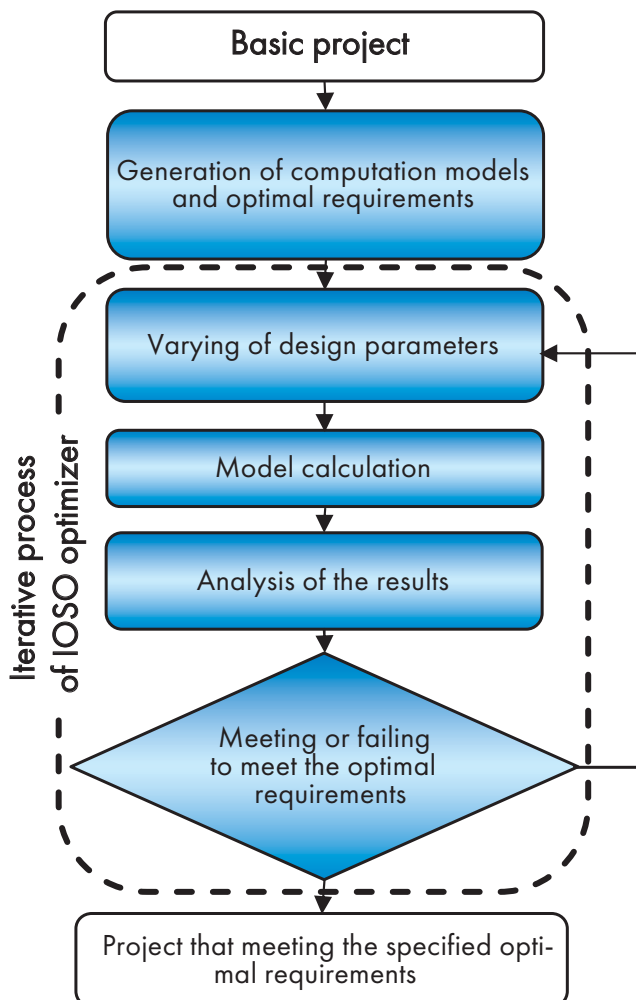
Search for Optimal System Management Laws

IOSO NM has a large number of applications for optimization of system management laws. It is often necessary to select or co-ordinate management parameters for the system while it is in operation in order to achieve a certain effect during the operation of the system or to reduce the impact of some factors on the system.
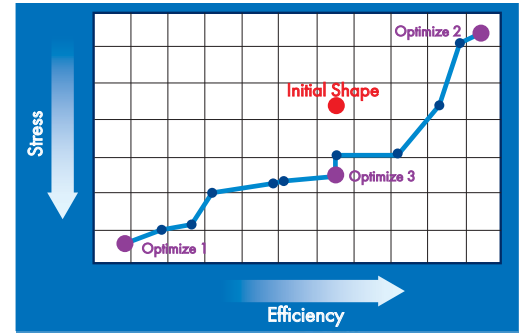
Identification of Mathematical Models

When the design process involves the use of any mathematical models of real-life objects, whether commercial or corporate, there is the problem of co-ordinating the experiment findings and model computation results. All models imply a set of unknown factors or constants. Searching for the optimal values thereof makes it possible to co-ordinate the experiment findings and model computation results.

The power and flexibility of IOSO NM optimization algorithms provide the researcher with an opportunity to solve optimization problems which have not been targeted before as they required so much effort to be solved.

Basic project

Generation of computation models and optimal requirements

Varying of design parameters

Model calculation

Analysis of the results

Meeting or failing to meet the optimal requirements

Iterative process of IOSO optimizer

Project that meeting the specified optimal requirements

## Pareto set optimization results for a 2 objective optimization task

Special Features

The IOSO NM software package is based on IOSO, a fundamentally new strategy for solving optimization problems. It is highly efficient and has the following distinctive features:

- Unique high-performance algorithms for solving large-scale problems (with multiple (up to 20) independent criteria or multiple (up to 100) independent variables)
- Low cost of searching for a solution
- Intuitive interface and easy-to-use optimization algorithms which require no special knowledge from the user

Stress distribution in blades of the fan under optimization

Initial state   Optitmized
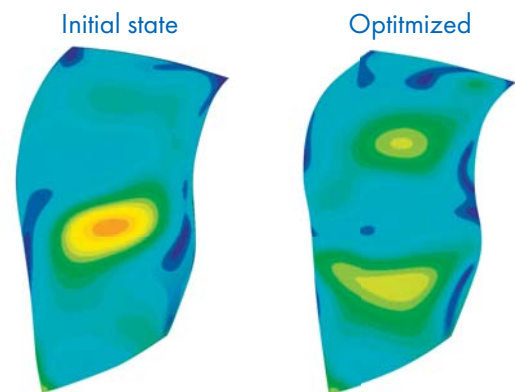
IOSO NM in use

While designing a technical system or any other object, whether an air or a motor vehicle, a mathematical economics model, etc., the designer performs one and the same series of actions:

- Development of the basic project concept
- Generation of computation models for computing key performance indicators

- Assessment of a set of options meeting or failing to meet the specified optimal requirements

Without the use of specialised optimization tools, the designer encounters an infinite number of combinations of project variables and is forced to substantially limit the scope of optimal values to be searched for, which actually has a negative impact on the output.

IOSO NM enables the designer to easily integrate all computation models into a single computation unit and automate the optimal solution search process based on the IOSO optimization technology embedded in the software product.

"We assume that mathematical models and software packages for creating objects or performing model calculations (however full and accurate they may be) is not a sufficient condition for successful design and modification of modern technical and other systems. Creating competitive samples requires integration of mathematical models, modelling applications or a real-life object with search methods of study as part of a single 'optimization environment'. This environment is what we call optimization technology."

<div align="right">Prof. Egorov I.N.</div>

User Interface

IOSO NM enables the user to set up the research project quickly, even for very complex multidisciplinary problems.
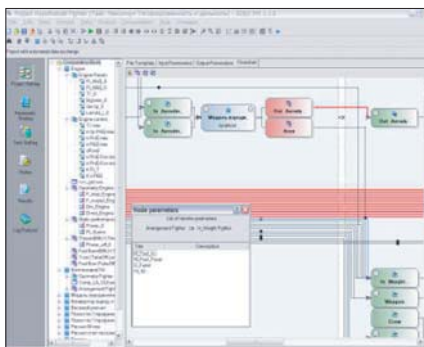
IOSO NM makes it possible to adjust the input and output settings easily, as shown in the next figure.

The tabular and graphical representations of optimization results enable on-the-fly analysis of generated solutions and identification of further
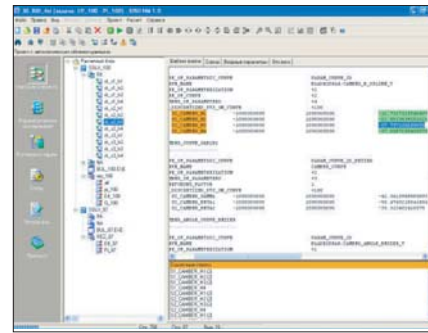
research areas. The results can be analysed either in or after the process of solving the problem.

Application

IOSO NM has a wide target audience and is intended for use in a wide variety of human activity areas in order to:
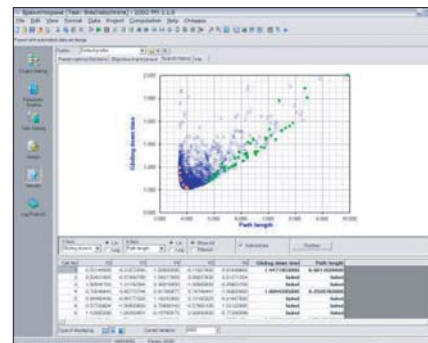
- Improve the performance of technical and other systems, technological and other processes
- Identify the optimal management laws for complex devices
- Identify and verify mathematical models of objects and systems based on the findings of experiment

Applications:

Aerospace, Automobile, Oil & Gas, Medicine, Economics, Optics, Chemistry, Biotechnology, Electronics, Marine

Compatibility

IOSO NM works under Windows 2000/XP operating systems and enables integration into an optimisation project of computation models on remote computers running under Windows 2000/XP and Unix/Linux operating systems.

SIGMA technology

Integration with various CAE applications, commercial and corporate.

IOSO NM is successfully used to solve practical tasks for the leading companies and engineering cenetres in Russia and all over the world.

Participation in Conferences

The high efficiency of the IOSO technology is recognised by leading Western specialists. Works related to its use have been published by AIAA, ASME, EUROGEN, ECCOMAS, ASMO-UK, IGTI and others.

For customers which solve complex time consuming optimization problems Sigma Technology offers parallel optimization software IOSO PM. IOSO PM enables to efficiently use the potential of multiprocessor systems, local area networks and sufficiently reduce total optimization time.