

**International scientific workshop “Innovative technologies in control systems”/  
Международный научно-технический семинар «Иновационные технологии  
в системах управления»**

Workshop program/

**Section 1. Technology and properties of promising crystalline materials / Технологии получения и свойства перспективных кристаллических материалов  
Section chair: D. Cochet (Comadeur, Switzerland)**

**Section2. Advances in Industrial and Civil automation / Достижения в области промышленной и автоматизации и автоматизации гражданского сектора  
Section chair: Milan Stefanovic (STI Innsbruck, Austria)**

**Section 3. Problems of engineering enterprise planning and control of production manufacturing / Проблемы планирования работы промышленного предприятия и управления процессами выпуска продукции  
Section chair: V.P. Rudenko (EZAN, Russia)**

**Section1. Section 1. Technology and properties of promising crystalline materials / Технологии получения и свойства перспективных кристаллических материалов  
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**Section 3. Problems of engineering enterprise planning and control of production manufacturing / Проблемы планирования работы промышленного предприятия и управления процессами выпуска продукции**  
**Section chair: V.P. Rudenko (EZAN, Russia)**

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## NEW ALGORITHMIC AND TECHNICAL SOLUTIONS USED IN TRANSISTOR POWER CONVERTERS WITH POWER OF MORE THAN 100 KW FOR INDUCTIVE HEATING

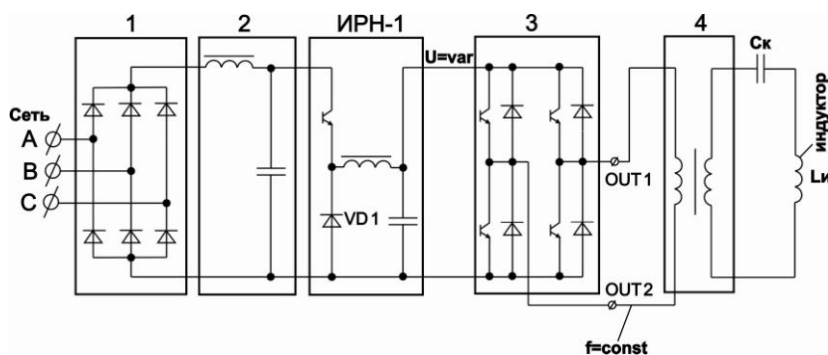
### Annotation

The crystal growth equipment using the Stepanov/EFG method applies inductive heating. It is continually improved and sets high requirements of the transistor power converter which is a part of the crystal growth equipment. These requirements are both inverter output power increase and improvement of its operating characteristics due to the application of new algorithms.

### Keywords

New algorithms, transistor power converter, inductive heating, improvement operating characteristics, power circuit, matching device.

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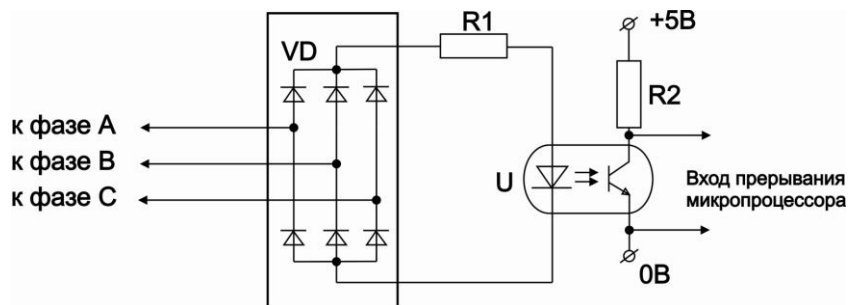
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## A CALCULATIVE THEORETICAL MODEL OF PHOTOCHEMICAL REACTOR BASED ON THE SOURCE OF HIGH-INTENSITY RADIATION WITH CONTINUOUS SPECTRUM

### Annotation

A general description of the theoretical model of the photochemical reactor with pulsed xenon lamp is reported. It allows simulating various reactor designs. Experimental comparison of the effectiveness of designs before and after optimization for the EDTA destruction is shown.

### Keywords

Pulsed xenon lamp, photochemical reactor, numerical simulation, EDTA.

□



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APPLICATION OF COMPUTER-AIDED DESIGN AND ENGINEERING SYSTEMS FOR DESIGN OF HIGH-TEMPERATURE FURNACE AND THERMAL UNIT FOR ANNEALING OF SILICON CARBIDE EPITAXIAL WAFERS

Annotation

The report describes the application of computer-aided design and engineering calculations software for design of the high-temperature furnace and thermal unit for annealing of sic epitaxial wafers. The use of these systems significantly shortens time of equipment design and allows making of a complex technological equipment with minimal breadboarding and experimental research.

Keywords

CAD, CAE, high-temperature furnace, high-temperature treatment.

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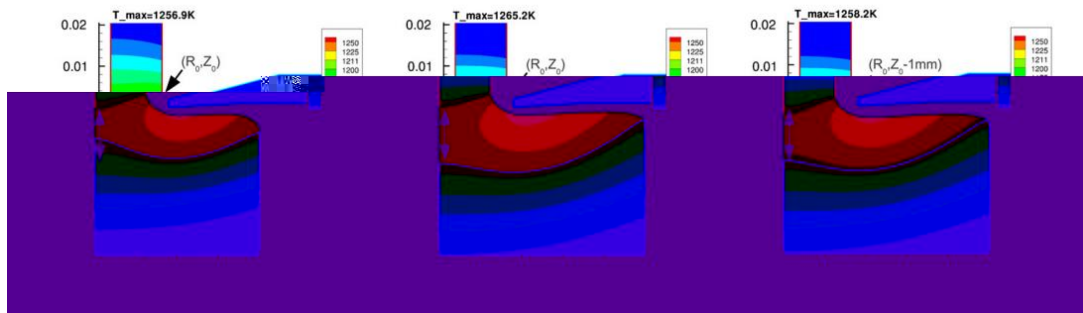
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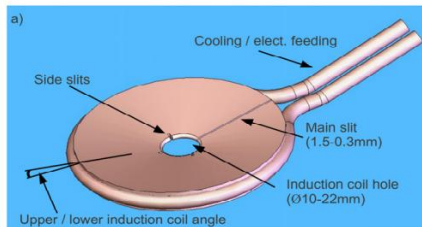
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Commonly, germanium crystals are grown after the Czochralski (CZ) method. The crucible-free pedestal and floating zone (FZ) methods, which are widely used for silicon growth, are hardly known to be investigated for germanium. The germanium melt is more than twice as dense as liquid silicon, which could destabilize a floating zone. Additionally, the lower melting point and the related lower radiative heat loss is shown to reduce the stability especially of the FZ process with the consequence of a screw-like crystal growth. We found that the lower heat radiation of Ge can be compensated by the increased convective cooling of a helium atmosphere instead of the argon ambient. Under these conditions, the screw-like growth could be avoided. Unfortunately, the helium cooling deteriorates the melting behavior of the feed rod. Spikes appear along the open melt front, which touch on the induction coil. In order to improve the melting behavior, we used a lamp as a second energy source as well as a mixture of Ar and He. With this, we found a final solution for growing stable crystals from germanium by using both gases in different parts of the furnace. The experimental work is accompanied by the simulation of the stationary temperature field. The commercially available software FEMAG-FZ is used for axisymmetric calculations. Another tool for process development is the lateral photo-voltage scanning (LPS), which can determine the shape of the solid liquid phase boundary by analyzing the growth striations in a lateral cut of a grown crystal. In addition to improvements of the process, these measurements can be compared with the calculated results and, hence, conduce to validate the calculation.



Calculated temperature field for a 25 mm crystal; left: smaller feed rod; middle: optimized starting configuration; right: triple point moved downward by 1 mm



(a) Parameter for the induction coil design. (b) Induction coil with a conical angle of 7 deg.



Germanium crystal of 35 mm in maximal diameter (down) with an axial longitudinal cut after structural etching. After 20 mm the material is not single crystalline anymore.

Keywords

KeywordsA1. Heat transfer  
 Floating zone technique  
 Growth from melt  
 Semiconducting germanium

# MAGNETIC FIELD CONTROLLED SINGLE CRYSTAL GROWTH AND SURFACE MODIFICATION OF TITANIUM ALLOYS EXPOSED FOR BIOCOMPATIBILITY

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The aim of this work is growth and characterisation of Ti55Nb45 (wt%) single crystals by floating-zone single crystal growth of intermetallic compounds using two-phase radio-frequency (RF) electromagnetic heating. Thereby, the process and, in particular, the flow field in the molten zone is influenced by additional magnetic fields. The growth of massive intermetallic single crystals is very often unsuccessful due to an unfavourable solid liquid interface geometry enclosing concave fringes. It is generally known that the crystallization process stability is enhanced if the crystallization interface is convex. For this, a tailored magnetic two-phase stirrer system has been developed, which enables a controlled influence on the melt ranging from intensive inwards to outwards flows. Since Ti is favourably light, strong and biocompatible, it is one of the few materials that naturally match the requirements for implantation in the human body. Therefore, the magnetic system was applied to crystal growth of Ti alloys. The grown crystals were oriented and cut to cubes with the desired crystallographic orientations [1 0 0] and [1 0 1] normally on a plane. The electron backscatter diffraction (EBSD) technique was applied to clearly determine crystal orientation and to localize grain boundaries. The formation of oxidic nanotubes on Ti surfaces in dependence of the grain orientation was investigated, performed electrochemically by anodic oxidation from fluoride containing electrolyte.

## Keywords

Biomaterial

Floating-zone technique

Single crystal growth

Titanium compounds

V. Grilo<sup>a,b,\*</sup>, F. Rosi<sup>b</sup>

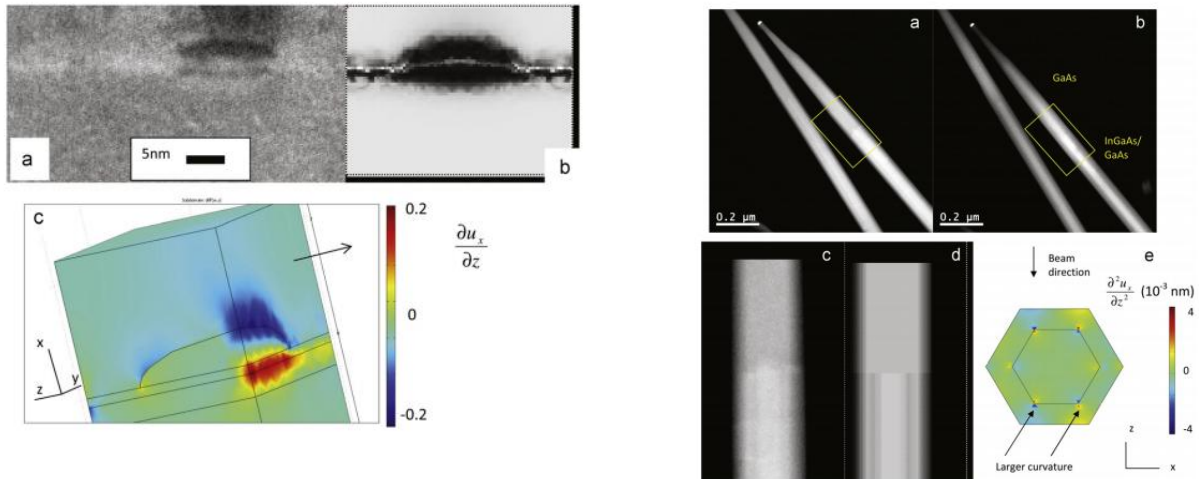
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Scanning TEM with a High Angle Annular Dark Field (HAADF) detector is an outstanding tool for chemical analysis; it permits to image compositional variations at atomic scale as variation in the image intensity. However in the interpretation of HAADF images the role of elastic strain and crystallographic defects are often neglected. For low index specimen orientation crystal imperfections can become very important due to the interplay of strain and channeling effects. Thanks to a recently developed channeling model, the main strain effects on the image can be predicted. An adequate description of these phenomena makes HAADF an interesting technique to complement or substitute traditional TEM characterization in many relevant materials science contexts. Examples will be shown for the case of semiconductor quantum dot, core shell nanowires and dislocations.



Experimental HAADF image of an InAs QD partially cut by the surface of the TEM foil; (b) CS simulation of the QD contrast based on finite elements modeling; (c) section of the finite elements modeling of the QDs with surface relaxation in the direction indicated by the arrow. The color scale indicates a different bending of the atomic columns.

(a) Two InGaAs/GaAs core shell nanowires imaged down the [1 100] zone axis. In the region indicated by the rectangle the wire passes from core-shell to pure GaAs with a quite sharp interface. A gold catalyst particle is visible on top of the right wire; (b) same as (a) but imaged a few degrees off axis. The compositional transition can be hardly appreciated; (c) detail of the rectangle in (a); (d) simulation of the contrast in the same transition region as (c); (e) finite element modeling of a section of the wire. The color scale indicates different values of the column curvature that concentrates at the edges indicated as

Keywords

Electron microscopy  
Defects  
Quantum Dots  
Annular Dark Field

## MODULAR PROCESSING LASER SYSTEM FOR SAPPHIRE CUTTING

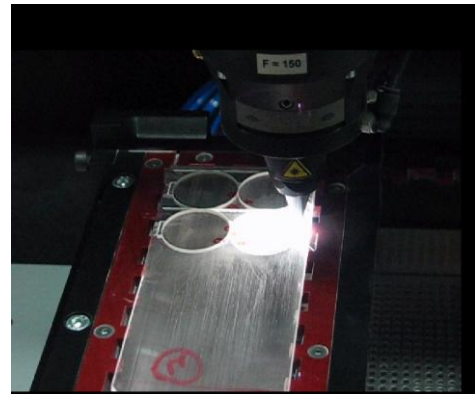
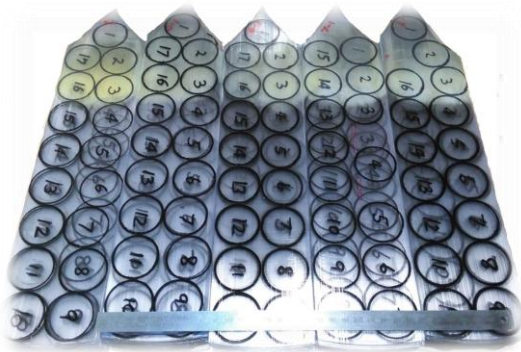
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The modular processing workstation MPS (Modular Processing System) covers an extremely wide field of applications. With its modular design, it can be easily modified to the intended application. Your spacious work chamber also provides extensive room for optical systems. If applicable, the laser beam is provided via one or more optical fibers.

With its modular design, the MPS is suitable for a wide range of laser applications. With repetition accuracies of point and seam welding as well as fine and high-speed cutting. The MPS is also particularly suitable for drilling and scribing.

Four basic modules are available for selection:

- Motorized Z axis with 350 mm travel distance
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- Particularly suitable for scanner applications
- Moving processing head with 3 axes
- Thus can be integrated in production lines
- Travel distances 400 x 400 x 350 mm (X Y Z)
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- The main applications are laser welding and scanner processing



## ALEXANDRITE CRYSTALS GROWTH AND APPLICATIONS

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Among solid-state laser crystals, Alexandrite is the most suitable for a wide range of medical applications due to its physical properties, such as the lasing wavelength and tunability. In fact, Alexandrite is the first of a class of tunable solid-state laser materials. It features a broad tuning wavelength range, 710 - 800 nm, with capability to store/efficiently extract multi-J energy pulses.

It is one of the most robust solid-state laser materials available with a thermal shock resistance five-times that of Nd:YAG.

dermatology, lithotripsy, dental, spectroscopy, atmospheric lidar, testing of fiber optics and photodetectors, materials processing, pumping of dye lasers, non-linear optics studies and annealing of semiconductors.

Typical applications include laser-assisted hair removal, leg vein reduction and tattoos removal: as matter of fact Alexandrite is becoming the material of choice for a variety of aesthetic dermatology.

Alexandrite lasers emit at a wavelength of 755 nm, that is well within the absorption spectrum of melanin, and this makes the laser perfectly suitable for removing hair. The absorption by melanin in the skin results also in hypopigmentation, enabling the use of these lasers for treatment of pigmented lesion, such as removal of green-blue-black tattoos, brown pigment spots, lentigines and age spots.

Ultra-pure gas and superior raw material purity, together with a tightly controlled proprietary process, allow Opto Materials to proudly offer premium grade Alexandrite crystal rods with low losses and higher efficiency.

Cr concentration uniformity along each rod is achieved by using only a small portion (about 20%) of the melt. A very uniform Cr profile is certified for each boule, that is also marked with laser for identification.

In-house coating allows a short cycle time after end polishing, assuring high adherence and contamination-free layers.

### General Features

- Low losses and superior lasing efficiency
- Certified Cr concentration uniformity
- Low wavefront distortion
- Multiple specifications on sizes
- Guaranteed traceability through laser marking
- Long term stability
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## TECHNOLOGY AND AUTOMATED EQUIPMENT FOR THE PRODUCTION OF PROTECTIVE SAPPHIRE SCREENS FOR PORTABLE MOBILE DEVICES

### Annotation

Currently, the major manufacturers of mobile communication devices (smartphones, tablets) started to use sapphire as a protective material for a screen. Strength and high hardness of sapphire significantly improve consumer quality of smartphones, and is just necessary for devices required for a special purpose. The mass use and substitution of traditional chemically toughened glass with sapphire so far limited due to its high cost of production and mechanical processing.

EZAN develops and delivers high-performance industrial equipment and technology for production of shaped sapphire crystals. The equipment and technology has advantages it terms of cost and productivity over the well-established techniques used for commercial production of protective screens for mobile devises.

### Key words

Mobile devices, sapphire, crystal growth.



Heat exchange method).

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2. A Durable and Scratch-Free Screen Cover Material for Next-Generation Mobile and Touch Screen Devices. URL: [www.gtat.com/7a480e6e-3b40.../download.htm](http://www.gtat.com/7a480e6e-3b40.../download.htm)

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SONATA NEW FULL-SCALE SCADA SYSTEM FOR INDUSTRY AND POWER ENGINEERING

Annotation

This report is about the functionality and features of the architecture of SCADA system "Sonata". It is used for creation of the automated process control systems (PCS) in various sectors of industry, energy and transport.

Keywords

Automatic control, process technology, industry

SCADA

SCADA (*Supervisory Control And Data Acquisition*, )

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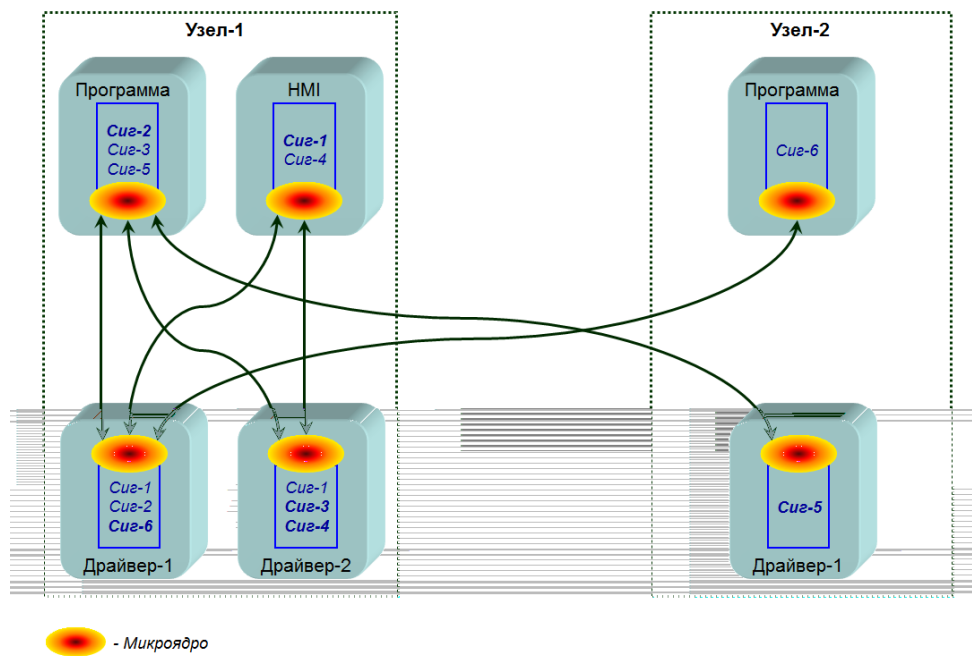
- FBD (Function Block Diagram)
- LD (Ladder diagram)
- ST (Structured text)



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SCADA

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## SESAME-S: SEMANTIC SMART SYSTEM FOR ENERGY EFFICIENCY

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Rising energy costs have created an increased need for energy-efficient systems, and an increased demand for energy-saving solutions around the world. To respond to these *rapidly growing markets* of energy efficiency, our work focuses on the design of highly personalized services based on a sensor and smart meter-enabled data-intensive smart home system and building automation. Energy efficiency remains a topic of growing importance. According to the Analyst Briefing Presentation on the Global Smart Homes Market, the Global Smart Homes market *"is estimated to be \$ 13.4 billion by 2014, growing at a CAGR of 16.5 % from 2009 to 2014. The smart homes market is segmented into products and services markets which are expected to grow at a CAGR of 16.3 % and 17 % respectively"* Achieving a 20 % reduction on primary energy use by 2020 through improved energy efficiency is one of the key measures of the 20-20-20 targets to keep CO emissions under control, and includes the well-known introduction of smart meters on a European-wide basis, to be implemented within the next few years. A recently set and even more ambitious EU goal is to cut greenhouse gas. Success in applied services-driven research and industrial settings largely depends on the ability to identify promising directions and technologies and to invest in those that will eventually lead to economically viable services or products. In this work, we focus on designing and evaluating end-consumer energy-efficient services that are grounded on and perform fine-grained processing of semantic linked data, unleashing the current large commercialization potential of semantic data. Specifically, *we analyze the end-consumer acceptance of a semantic smart home system enabling energy efficiency*. Semantic data stem from the Semantic Web [which represents the next-generation World Wide Web, where information is published and inter-linked in order to facilitate the exploitation of its structure and semantics (meaning) for both humans and machines. To foster the realization of the Semantic Web, the World Wide Web Consortium developed a unified metadata model (RDF), ontology languages (RDF Schema and OWL variants), and query languages (e. g., SPARQL). Research in the past several years has been primarily concerned with the definition and implementation of these languages, the development of accompanying ontology technologies, and applications in various domains, as well as currently, on publishing, linking and control.

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## HOW TO CREATE OWN ERP SYSTEM FOR ENGINEERING ENTERPRISES WITH DIVERSIFIED PRODUCTION

### Annotation

This article describes practical aspects of creation an own ERP system oriented for optimize manufacturing processes, reducing production cost on engineering enterprises with low-volume or pilot production.

### Keywords

Lean production, Adaptive control, Simulation modeling, Evolutionary algorithms.



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## HOW TO OPTIMIZE MANUFACTURING PROCESSES OF ENGINEERING ENTERPRISE USING EVOLUTIONARY ALGORITHMS

### Annotation

This article describes practical aspects of development an own ERP system oriented for optimize manufacturing processes on engineering enterprises using evolutionary algorithms.

### Keywords:

Evolutionary algorithms, Software production, Simulation modeling, Optimize production.

*Multiple Data, SIMD*

*CUDA*

*SIMD-*

*Single Instruction*

GPU

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NVIDIA