ANNOTATION
of dissertation in candidacy for a scientific degree Doctor of Philosophy (PhD) 
specialty 6D075100 – Informatics, computer engineering and management 
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Design and development of the distributed high-performance information system for the analysis of gel-polymer flooding of oil field within the concept of I-FIELDS

**General characteristics of the work.** The thesis is devoted to the research and development of a distributed information system of analysis gel-polymer flooding of oil fields within the concept of I-fields, based on modern mathematical models of fluid flow in porous media and parallel computing algorithms using MPI and CUDA technologies.

**Relevance of the work.**
With the development of the computing technology and high-performance systems in the world, is increased the efficiency of solving problems in the engineering research. Mathematical and computer modeling of underground oil reservoirs, development and analysis of deposits using modern high-performance computing technology is no exception. Most of the world and Kazakhstan oil companies uses hydrodynamic simulators for the oil field research. Hydrodynamic models developing every year and more detailed investigation of the physical and chemical properties of underground fluids. Also, develop modern numerical methods for solving complex problems in oil fields, increases the amount of computation. In this context, the relevance of the use of high-performance computing and computing technology in the oil industry is growing every year.

In the middle stages of development of oil deposits invariably raises the complex problem of reducing oil recovery coupled with the drop in reservoir pressure and increasing water cut. Polymer injection method is widely used in the petroleum industry as water thickeners and is regarded as one of the most effective tertiary EOR methods.

**Goal of the research.**
The aim of the dissertation research is to develop a distributed information system analysis of oil field development, allowing rapid decision-making and optimal exploitation of deposits, the study of the mathematical model of non isothermal filtration by gel-polymer flooding.

**Subject and object of research.**
Subject of study are the mathematical models and computational algorithms of non-isothermal fluid flow in porous media. As well as modern high-performance computing and information technologies for an adequate assessment of processes.

**Research methods.**
We used methods of mathematical modeling of oil displacement by polymer injection, numerical methods, programming techniques for creating online portals and parallelization techniques based on MPI technology and CUDA.

**Scientific novelty of the work** is developing of:
- mathematical model of non-isothermal oil displacement process by polymer flooding;
- parallel computing algorithms for solving problems of enhanced oil recovery by injecting chemicals;
- technology of distributed computing over the Internet;
- development of the "Polymer flooding" module for distributed information system analysis of oil field
- prototype of web-hydrodynamic simulator on mobile platforms;
- the preparatory works for the implementation of a full i-fields system in Kazakhstan.

**Theoretical and practical value of the research.**

The scientific research has a high degree scientific novelty and practical significance. The developed models and algorithms contribute directly to the development of science in the oil and gas industry and information technology of the country. The practical value of the work lies in the fact that the developed models and algorithms can be used not only in the oil industry, but also in medicine and biology. The obtained results and applications can be used for data analysis and forecast exploitation conditions at work in system of injection and production wells.

**The degree of validity and reliability.** The reliability of the obtained results was proved by verification of the proposed model in two stages: a comparison of numerical results with laboratory experiments and with results of calculations on the hydrodynamic simulator Eclipse BlackOil. The main results published in various scientific journals, journals cited in SCOPUS, as well as numerous discussions at international conferences and seminars held at University of Lorraine (France) and al-Farabi Kazakh National University.

**The relation of topic to the plans of scientific research programs.**

The thesis is carried out as part of research work "Modernization of information system for analysis of oil fields development (ISAR-II)" with registration № 0113PK00514 performed in Scientific research Institute of Mathematics and Mechanics according to grant funding, designed for 2012 – 2014 years.

**Approbation of the work.** 15 works are published, including: 4 in journals recommended by committee, 2 in the journal indexed by SCOPUS, 2 in the proceedings of abroad international conferences and 7 other publications.