

**Project name:** AP19679190 «Research and optimization of intelligent reflective surface technology using artificial intelligence»

**Security features:**

An intelligent reflective surface that allows you to control the wireless transmission environment is seen as a promising technology for improving spectrum and energy efficiency in future wireless communication systems. Previous work on the intelligent reflective surface is mainly based on the ideal phase shift model, since it summarizes the complete signal picture of each of the elements, regardless of its phase shift, but it is difficult to implement in practice. On the contrary, in this project, we propose a practical phase shift model that captures phase-dependent changes in the reflection coefficient amplitude over an element. Applying this new model to an intelligent wireless system with a reflective surface, we formulate the problem of maximizing the speed that it can achieve by jointly optimizing the transmission radiation and forming an intelligent reflective beam with a reflective surface. The formulated problem is difficult for optimal solution not only in the case of a convexity, but also in the general case, for which we propose a simple suboptimal solution based on the variable optimization method. The simulation results will reflect significant performance gains achieved by jointly optimizing beamforming based on the proposed phase shift model compared to the traditional ideal model.

**Goals:**

The goal of our project is that we present for the first time a practical model of phase shift both in Kazakhstan and around the world, and based on this model, we formulate and implement a new problem to increase the speed that it can achieve by jointly optimizing transmission radiation and intelligently forming a reflective beam on a reflective surface.

**Expected results:**

An analysis of the results of research on optimizing the parameters of intelligent reflective surface technology was carried out, an analysis of the methods of optimizing the parameters of intelligent reflective surface technology was carried out, the use of special methods of physical optimization, signal coding and processing was substantiated, and a program of technical requirements for communication technology was developed. The structure and scheme of a mathematical model for optimizing the parameters of intelligent reflective surface technology have been developed. An algorithm and program for optimizing the parameters of intelligent reflective surface technology has been developed. Optimization of the parameters of intelligent reflective surface technology and the results of the study were obtained. An experimental mathematical model of a built-in antenna with optimized parameters of intelligent reflective surface technology was developed. Recommendations and optimization requirements for the use of intelligent reflective surface technology parameters optimization parameters have been developed. Form of completion: a report on the research work was submitted.

As of 2023: With the help of artificial intelligence, scientific literary sources and patent analysis of intelligent reflective surface technology were carried out. In the course of the analysis, scientific sources with more than five hundred patents were considered. Objectively analyzed the results of the study of the parameters of intelligent reflective surface technology using artificial intelligence. A program has been prepared to develop technical requirements (TT) for intelligent reflective surface technology using artificial intelligence. Justification for modeling the parameters of the technological scheme and algorithms for determining digital information signs for determining communication quality indicators in intelligent reflective surface technology have been developed. Intelligent reflective surface technology was based on optimizing parameters. Intelligent reflective surface technology has developed the requirements and requirements for modeling parameters. Completion form: a summary of the project was given, an article was published in 1 periodical Journal. The expansion of international scientific cooperation with the world's leading universities was carried out, that is, 3 scientists from the scientific group exchanged scientific experience.

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