**INFORMATION ABOUT RESEARCH RESULTS**

Dissertation title: **Apply artificial intelligence algorithms to calculate optimal grid expansion planning**

Specialization: Electrical Engineering Code: 9520201

Full name of PhD student: Tran Huu Tinh Course: 2016

Scientific supervisor:

Associate Professor Ph.D. Vo Ngoc Dieu

Associate Professor Ph.D. Quyen Huy Anh

Training institution: Ho Chi Minh City University of Technology Education

1. **Summary of content**

The main objective of power grid expansion planning is to determine the location and scope of necessary expansion, decide on the required capacity, estimate the total cost of planning, and enhance the reliability of the power system. This is a large-scale, complex problem involving nonlinear and mixed-integer factors. Finding an accurate solution to the power grid expansion planning problem is crucial in the electrical industry. The application of optimization methods has yielded many positive results for this issue. The dissertation has researched and applied the mathematical optimization method and the new artificial intelligence algorithms to address the power grid expansion planning problem, achieving feasible results as follows:

- Apply the bound and branch algorithm to solve the planning and expansion problem of the power transmission system with reliability constraints in real areas of the Mekong Delta, Ben Tre province, and Hau Giang province. This expansion planning problem sets standard reliability conditions to optimize the electrical system and verify the system after expansion. In addition, the dissertation also addresses the development of multi-objective problems with multiple combined constraints to better reflect the development of the power grid in the future. This is an important basis for applying artificial intelligence methods to solve the power grid expansion planning problem, especially when there are reliability requirements. This method is tested on IEEE standard power systems and practical power grids in the Mekong Delta.

- The Crow Search (CS) algorithm and Cuckoo Search Algorithm (CSA) have demonstrated their effectiveness in solving current power transmission system planning problems. These are fast and accurate optimization methods for planning and expanding transmission systems, validated on IEEE standard power systems with published international papers.

- Utilizing the Modified Particle Swarm Optimization (MPSO) algorithm to tackle the distribution system planning problem, a novel mutation method aimed at enhancing global search capability and mitigating premature convergence to local minima has been incorporated. The achieved results have been compared with those of various other methods in the literature.

The dissertation content has implemented artificial intelligence algorithms based on the search process of natural species such as cuckoos, crows, and swarms. These algorithms have been applied to the transmission and distribution expansion planning problems. The results obtained have demonstrated the effectiveness of these algorithms when applied to the grid expansion planning problems and proposed directions for the development of artificial intelligence algorithms in real power grids in Vietnam.

From the research works as well as practice the topic ***“Apply artificial intelligence algorithms to calculate optimal grid expansion planning”*** with the goal of solving the power grid expansion problem through the artificial intelligence methods as follows:

- The application bound and branch algorithms solved the transmission expansion planning problem and proved the effective algorithm through the real power grids in the Mekong Delta and other provinces such as Ben Tre and Hau Giang provinces.

- This is to develop a new optimal search algorithm based on the searching behavior of crows and cuckoo birds with the goal of finding the optimal solution to the transmission expansion planning problem.

- Apply the modified PSO algorithm to the distribution power grid planning problem and check the effectiveness by comparing it with many other methods on the same power network.

1. **New contributions of the topic**

In this research direction, the new Crow search algorithms and Cuckoo search algorithms built and applied to solve the transmission expansion planning problem in order to the optimal expansion planning problem for the DC transmission grid solve most quickly and accurately. In this thesis, the following contents has been considered:

- Research the transmission expansion planning problem considering the constraints on reliability. The DC transmission grid planning problem considering the constraints on node current balance, limit power distribution limits on lines, priority rights, node voltage phase angle limits. The distribution expansion planning problem considering the constraints on node voltage limits, transmission power distribution, generation capacity, power network structure rays, node power balance, line capacity, station capacity, distributed generation capacity, budget constraints.

- The application bound and branch algorithms solved the transmission expansion planning problem with reliability constraints in the real power grid in Ben Tre province, Hau Giang province, and the Mekong Delta region.

- The research found the strengths of the CS and CSA algorithms to find the optimal solution to the DC transmission grid planning problem proven on a standard power system. This will help the power system operators easily manage when complex loads grow.

- The research improved the PSO algorithm to apply the distribution grid planning problem to standard power system networks to improve global search ability and limit premature convergence to a local minimum level.

The purpose is to develop and solve the transmission planning and distribution planning problem, and the combining constraints achieved the most optimal solution.

## Ho Chi Minh City, ………., 2024

**PhD student**

**Tran Huu Tinh**