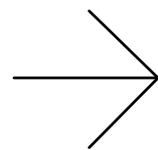# KTP
Case Study

Powerline
Technologies

About Powerline Technologies

Powerline Technologies (PLT) part of Fundamentals Ltd (power systems technology specialists), is delivering next generation Smart Grid Low Voltage (LV) and Medium Voltage (MV) distribution automation solutions to utilities and distribution System / Network Operators (DSO/DNO) worldwide.

Underground cables (UG) are used in locations such as urban areas where overhead lines rights of way is not available, in areas where local or state regulations override economic considerations, near airports, city centres and other locations where an overhead line may endanger lives, and in scenic areas where appearance is an important consideration. Installing underground lines can cost 7-10 times more than overhead lines. Underground cables are buried at a depth of 450mm to 1200mm depending on the working voltage level. For example, 415 V (450mm) 11 kV (900mm) and 33kV (1200mm).

If a fault occurs in the UG cables, excavation of the exact fault location is of paramount importance in terms of time, cost and customer satisfaction, etc. Also if the outage duration is longer than a certain period the Distribution Network Operator (DNO) is obliged to pay out compensation to customers. In the United Kingdom, there are 15 distribution network operator (DNO) regions. The 14 different district networks are managed by six operators, while one operator controls the distribution network in Northern Ireland (Figure below). The length of UG cable used by distribution companies depends on the coverage area of the DNO.

Determination of the exact fault location depends on accurate models of the cable and its associated arc. This project investigated both models mathematically for Powerline Technologies. These models will enable the PLT's machine learning algorithm to pinpoint the fault location for direct and immediate dispatch of repair crews to the location. It will also minimise multiple excavations, cable cutting and ground re-instatement.

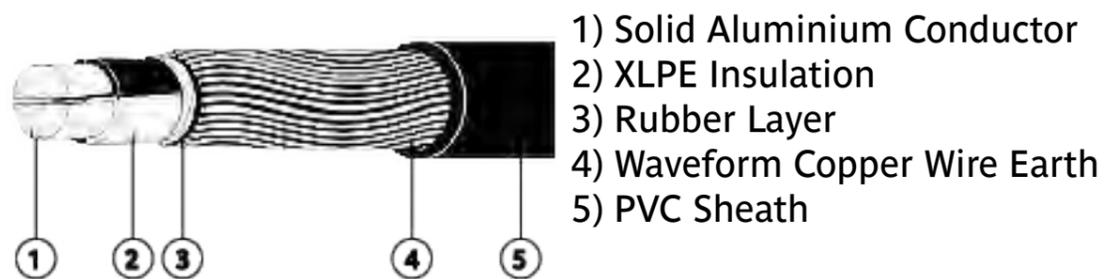Underground cable installation and excavations

Powerline Technologies (PLT) has developed a Low Voltage (LV) three core cable simulation model. The challenge now was to onward develop four core cable model and the arc model to increase its simulation accuracy.

1) Solid Aluminium Conductor
2) XLPE Insulation
3) Rubber Layer
4) Waveform Copper Wire Earth
5) PVC Sheath

Why KTP was the right mechanism to achieve this?

Powerline technologies' AI-based underground cable fault diagnostic and location equipment relies on an accurate digital model of the LV network to produce data to train the AI algorithms. This KTP enabled PLT to embed the developed cable model into the machine learning fault algorithm module.

- Customer
- Phase 1
- Phase 2
- Phase 3

0   20 m
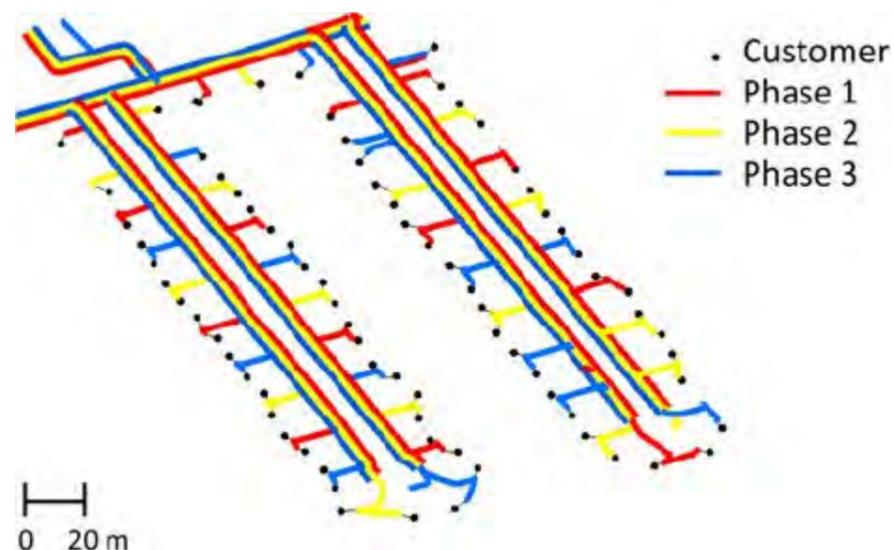
The KTP's focus was to improve two key aspects of underground cable model:

- The four-core MATLAB cable model with its associated parameters for integration into PLT's existing MATLAB network model.

- Improved arc fault models and their integration with the designed four-core cable model to more realistically represent the fault process within distribution network underground cables.
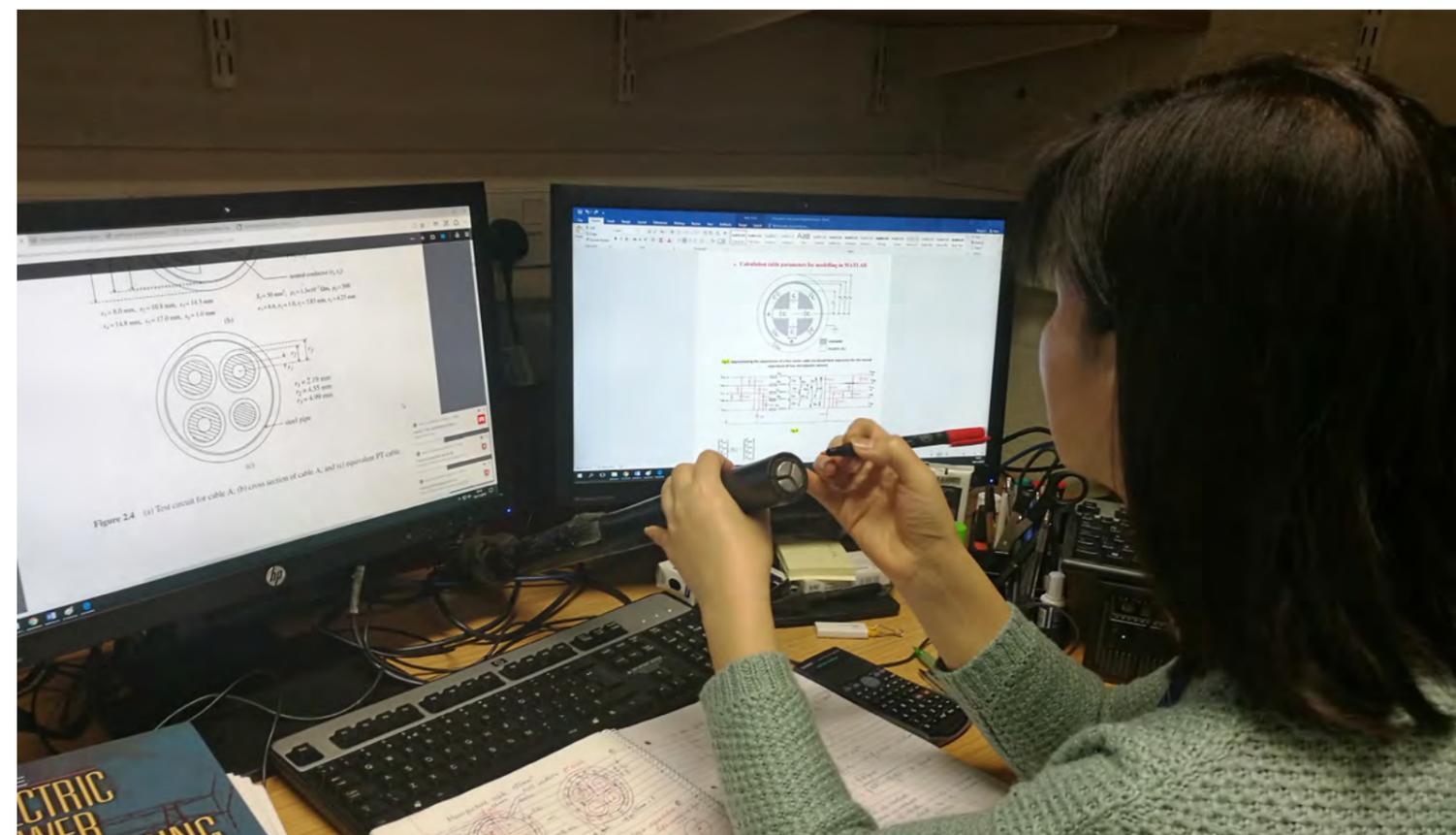
Outcome - Impacts & Benefits

What the partners are saying...

For Powerline Technologies:

- The four-core MATLAB cable model with its associated parameters for integration into PLT's existing MATLAB network model could be scaled up and validated.
- Widened understanding of suitability of various arc models in particular events

For UWE Bristol:

- Have further experience of data analysis and field measurement validation
- Gained knowledge how to train the AI algorithms for fault diagnostic and location

For the KTP Associate:

The KTP Associate has gained new knowledge in training and accessing the simulation software programmes and experience in handling the field measurement data.

"In addition to the modelling improvements, the KTP project showed how a collaboration between UWE and a research focused technology SME could increase the latter's knowledge and understanding of a challenging problem."

Dr Simon Le Blond, Power System Specialist, PLT

"Able to take gained knowledge from the KTP project to the classroom for the students. A seminar group has been taught, one of the benefits from the KTP."

Dr Hassan Nouri, Reader FET Engineering, Design & Mathematics, UWE Bristol

"KTP gave me the opportunities in skill training such as project management, team working, etc. These skills have not only helped me in managing the current project, but also support me in future career. In my role as an associate, I expanded my knowledge in solid technical and soft skills. I received a lot of support and valuable comments from a KTP adviser, academic and company supervisors"

Dr Le Trang, KTP Associate, UWE Bristol/PLT