# Transient based fault identification algorithm

*Ultra-fast single ended protection scheme based on travelling waves*

## CONTEXT

While more and more HVDC point-to-point connections are initiated worldwide, the emergence of multi-terminal grids still faces important hurdles among which the protection is seen as particularly challenging. Most of existing approaches for a selective faulty line identification relies on extra inductances to distinguish between internal and external line faults. Such inductances have an impact on cost and power system stability. Other fault identification algorithms rely primarily on communication between line ends, but this in turn bring limitation in term of execution speed.
In HVDC point-to-point systems mixing portion of cables and overhead lines it is important to discriminate fault location in order to enable fast automatic line reclosing in case fugitive faults. One way to this is by mean of extensive use of current sensors and communication between them.

## TECHNOLOGY DESCRIPTION

The proposed method is able to determine whether the line monitored by a relay is faulty or not using very few local measurements, making ultra-fast fault identification possible. When a fault is suspected, the proposed algorithm estimates the fault distance and impedance. The estimation process uses a parametric model describing the voltage and current evolution just after the fault occurrence based on the fault parameters. When a fault is suspected, an iterative maximum-likelihood (ML) estimate of the fault parameters is evaluated from the data available at the relay. The estimated fault parameters and their confidence intervals are exploited to determine whether or not one has to consider that a fault actually occurred in the protected line.
While this algorithm has been developed for HVDC line protection, it can be implemented for AC transmission line protection.

## APPLICATION DOMAIN

MTDC grid
HVDC point to point with mixing cable and overhead line
AC transmission line

## ADVANTAGES

Ultra-fast (fault distance 4% error for a time window <0,5 ms)
Single ended
No need for DC limiting reactor

## TRL SCALE

1 2 3 4 5 6 7 8 9

Algorithm developed in Matlab

## DELIVERABLES

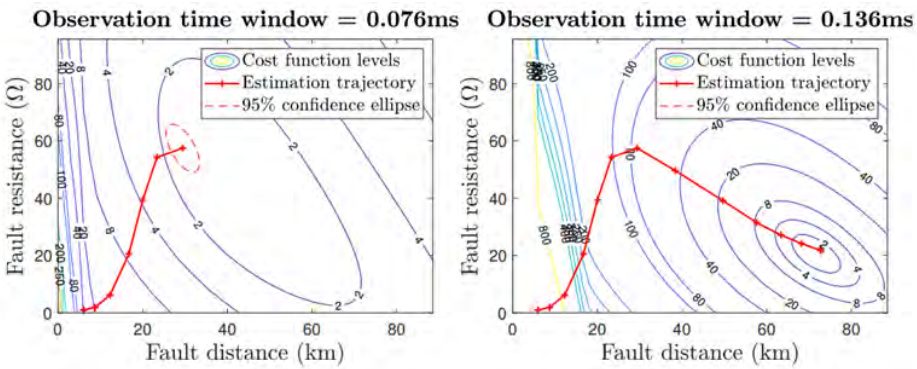
Patent application EP19305517
Technical reports, codes

## SCIENTIFIC REFERENCE

P. Verrax et. al. “Transient-based fault identification algorithm using parametric models for meshed HVDC grids”, journal EPSR 2020

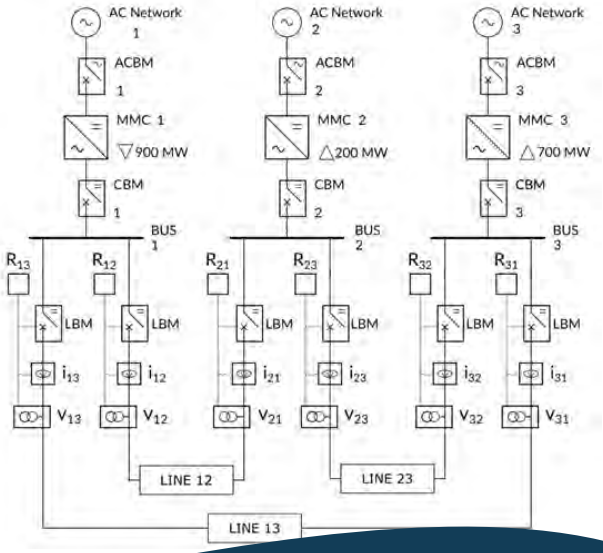
P. Verrax et. al. “A novel single-ended fault identification algorithm for full selective protection strategy”, DPSP IET 2020

P. Verrax et. al. “Fault identification in HVDC grids using a transient parametric model”, IFAC 2020




Simulations results of algorithm behavior for a fault at 80km with $R_f$=15Ω. Convergence of estimated parameters at two different iteration times.

Example of one line diagram, position of protection relays and measurements.



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