Making implicit knowledge of distance protective relay operations and fault characteristics explicit via rough set based discernibility relationship

ABSTRACT

This paper discusses the novel application of the discernibility concept inherent in rough set theory in making explicit of the implicit knowledge of distance protective relay operations and fault characteristics that are hidden away in the recorded relay event report. A rough-set-based data mining strategy is formulated to analyze the relay trip assertion, impedance element activation, and fault characteristics of distance relay decision system. Using rough set theory, the uncertainty and vagueness in the relay event report can be resolved using the concepts of discernibility, elementary sets and set approximations. Nowadays protection engineers are suffering from very complex implementations of protection system analysis due to massive quantities of data coming from diverse points of intelligent electronic devices (IEDs such as digital protective relays, digital fault recorders, SCADA's remote terminal units, sequence of event recorders, circuit breakers, fault locators and IEDs specially used for variety of monitoring and control applications). To help the protection engineers come to term with the crucial necessity and benefit of protection system analysis without the arduous dealing of overwhelming data, using recorded data resident in digital protective relays alone in an automated approach called knowledge discovery in database (KDD) is certainly of an immense help in their protection operation analysis tasks. Digital protective relay, instead of a host of other intelligent electronic devices, is the only device for analysis in this work because it sufficiently provides virtually most attributes needed for data mining process in KDD. Unlike some artificial intelligence aproaches like artificial nueral network and decision tree in which the data mining analysis is "population-based" and single since it is common to the entire population of training data set, the rough set approach adopts an "individually-event-based" paradigm in which detailed time tracking analysis of relay operation has been successfully performed.

Keyword: Data mining; Decision system; Digital protective relay; Distance protection; Knowledge discovery in database; Rough set theory