AUTOMATIC FAULT ANALYSIS IN POWER SYSTEMS
VIA APPLICATION SERVICE PROVIDER

by

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Abstract

Automatic Fault Analysis in Power Systems via Application Service Provider
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MIT., The University of Newcastle, Australia

This dissertation presents a new approach to automated fault analysis in electrical power systems. New contributions to the fault and disturbance investigation topic are automated fault analysis service (AFAS) via application service provider (ASP) and remote relay testing service (RRTS). The implementation of AFAS complies with the new international standard of communication network and system in substations (IEC-61850).

The signal processing approaches in an automated fault analysis service are based on the wavelet transform and empirical mode decomposition methods. Several case studies have been carried out to test the performance of the signal segmentation technique. The data for analyses are from simulated fault data and from real disturbance records obtained from the intelligent electronic devices (IEDs) in substations.

The implementation of AFAS and RRTS was developed using C# with .NET technologies, MATLAB and open source software. Signal segmentation, signal modelling, fault type classification, fault location service, a web-based COMTRADE viewer and remote relay test service have been developed in this dissertation. Such services are designed to enhance manual investigations performed by engineers. The services have been tested extensively using disturbance records from power utilities and a power system simulation model.
Statement of Originality

This work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

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<td>Abstract Communication Service Interface</td>
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<td>AFAS</td>
<td>Automated Fault and disturbance Analysis Service</td>
</tr>
<tr>
<td>ANN</td>
<td>Annunciator elements</td>
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<tr>
<td>API</td>
<td>Application Program Interfaces</td>
</tr>
<tr>
<td>ASP</td>
<td>Application Service Provider</td>
</tr>
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<td>ATP</td>
<td>Alternative Transient Program</td>
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<tr>
<td>CB</td>
<td>Circuit Breaker</td>
</tr>
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<td>CBMA</td>
<td>Circuit Breaker Monitor Analysis</td>
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<td>CFG</td>
<td>Configuration elements</td>
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<tr>
<td>COMTRADE</td>
<td>Common format for Transient Data Exchange</td>
</tr>
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<td>CON</td>
<td>Control elements</td>
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<td>CT</td>
<td>Current Transformer</td>
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<tr>
<td>CWT</td>
<td>Continuous Wavelet Transform</td>
</tr>
<tr>
<td>DFRs</td>
<td>Digital Fault Recorders</td>
</tr>
<tr>
<td>DFRA</td>
<td>Digital Fault Recorders Analysis</td>
</tr>
<tr>
<td>DPRA</td>
<td>Digital Protective Relay Analysis</td>
</tr>
<tr>
<td>DFT</td>
<td>Discrete Fourier Transform</td>
</tr>
<tr>
<td>DPRs</td>
<td>Digital Protective Relays</td>
</tr>
<tr>
<td>DWT</td>
<td>Discrete Wavelet Transform</td>
</tr>
<tr>
<td>EJS</td>
<td>Easy Java Simulation</td>
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<tr>
<td>EMD</td>
<td>Empirical Mode Decomposition</td>
</tr>
<tr>
<td>EMS</td>
<td>Energy Management System</td>
</tr>
<tr>
<td>FAFL</td>
<td>Fault Analysis with Fault Location</td>
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<tr>
<td>FFT</td>
<td>Fast Fourier Transform</td>
</tr>
<tr>
<td>FTP</td>
<td>File Transfer Protocol</td>
</tr>
<tr>
<td>GOOSE</td>
<td>Generic Object Oriented Substation Event</td>
</tr>
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<td>GUI</td>
<td>Graphical User Interface</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Definition</td>
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<tr>
<td>HPF</td>
<td>High Pass Filter</td>
</tr>
<tr>
<td>ICA</td>
<td>Independent Computing Architecture</td>
</tr>
<tr>
<td>IEDs</td>
<td>Intelligent Electronic Devices</td>
</tr>
<tr>
<td>ISP</td>
<td>Internet Service Providers</td>
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<tr>
<td>ISVs</td>
<td>Independent Software Vendors</td>
</tr>
<tr>
<td>IA</td>
<td>Instantaneous Amplitude</td>
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<tr>
<td>IMF</td>
<td>Intrinsic Mode Functions</td>
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<tr>
<td>IT</td>
<td>Information Technology</td>
</tr>
<tr>
<td>JIM</td>
<td>Java Internet Matlab</td>
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<tr>
<td>LAN</td>
<td>Local Area Network</td>
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<tr>
<td>LD</td>
<td>Logical Devices</td>
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<tr>
<td>LN</td>
<td>Logical Nodes</td>
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<tr>
<td>LPF</td>
<td>Low Pass Filter</td>
</tr>
<tr>
<td>MET</td>
<td>Metering and measurement elements</td>
</tr>
<tr>
<td>MMI</td>
<td>Man Machine Interface</td>
</tr>
<tr>
<td>MMS</td>
<td>Manufacturing Message Specification</td>
</tr>
<tr>
<td>MSD</td>
<td>Multi-resolution Signal Decomposition</td>
</tr>
<tr>
<td>OLE</td>
<td>Object Linking and Embedding</td>
</tr>
<tr>
<td>OPC</td>
<td>Ole for Process Control</td>
</tr>
<tr>
<td>PHP</td>
<td>PHP Hypertext Pre-processor</td>
</tr>
<tr>
<td>PRO</td>
<td>Protection elements</td>
</tr>
<tr>
<td>PSCAD</td>
<td>Power System Computer Aided Design</td>
</tr>
<tr>
<td>QMF</td>
<td>Quadrature Mirror Filter</td>
</tr>
<tr>
<td>RDP</td>
<td>Remote Desktop Protocol</td>
</tr>
<tr>
<td>RF</td>
<td>Fault Resistance</td>
</tr>
<tr>
<td>RMS</td>
<td>Root Mean Square</td>
</tr>
<tr>
<td>RPC</td>
<td>Remote Procedure Calls</td>
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<tr>
<td>RRTS</td>
<td>Remote Relay Testing Service</td>
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<tr>
<td>RTS</td>
<td>Relay Test System</td>
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<td>SAS</td>
<td>Substation Automation System</td>
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<td>SCADA</td>
<td>Supervisory Control and Data Acquisition</td>
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<tr>
<td>Abbreviation</td>
<td>Description</td>
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<td>--------------------------------------------------</td>
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<tr>
<td>SD</td>
<td>Standard Deviation</td>
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<tr>
<td>SEL</td>
<td>Schweitzer Engineering Laboratories</td>
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<tr>
<td>SER</td>
<td>Sequence of Event Recorder</td>
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<tr>
<td>SOA</td>
<td>Service Oriented Architecture</td>
</tr>
<tr>
<td>SOAP</td>
<td>Simple Object Access Protocol</td>
</tr>
<tr>
<td>TimeSeg</td>
<td>Time Segment</td>
</tr>
<tr>
<td>TLI</td>
<td>Test Laboratories International</td>
</tr>
<tr>
<td>UDDI</td>
<td>Universal Description and Discovery Interface</td>
</tr>
<tr>
<td>VNC</td>
<td>Virtual Network Computing</td>
</tr>
<tr>
<td>VT</td>
<td>Voltage Transformer</td>
</tr>
<tr>
<td>WAN</td>
<td>Wide Area Network</td>
</tr>
<tr>
<td>WAP</td>
<td>Wireless Application Protocol</td>
</tr>
<tr>
<td>WCF</td>
<td>Windows Communication Foundation</td>
</tr>
<tr>
<td>XML</td>
<td>eXtensible Markup Language</td>
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<tr>
<td>WS-AFA</td>
<td>Web Services for Fault Analysis</td>
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<tr>
<td>WSDL</td>
<td>Web Services Description Language</td>
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Conference Papers:


