SYNOPSIS

Partial Discharge (PD) measurements provide a sensitive and non-destructive assessment of the insulation system of a power apparatus They reveal vital information about design inadequacies and overall integrity of insulation Diagnostic monitoring is indispensable for optimizing life costs, since insulation still continues to be a major cause for most of the failures It is now well understood, that a comprehensive judgment on the status of insulation is possible, only when the relevant diagnostic data acquired under service-life conditions for a long interval of time are available Realizing this requirement, power utilities now-a-days lay greater emphasis on on-site, and even on-line PD measurements

With the advent of powerful, inexpensive computers and analog to digital converters, PD measurements were automated to a large extent, thereby enabling continuous monitoring and storage Digital PD measurement involves recording of every PD event (to the extent permissible by hardware) and quantifying their amplitude (q), the phase angle (ø) at which they occur over an interval of time PD data gathered from such measurements are referred to as ø-q-n patterns (images) Availability of digital data has enabled use of a variety of post-processing techniques

Given a scenario where each power apparatus is to be individually monitored (continuously or periodically) for a long interval of time, it is easy to visualize that a substantially large number of PD patterns will accumulate, that needs to be stored and processed Apart from storage and retrieval, analysis of data is crucial which is also computationally very intensive A study of the literature reveals, that because of these problems, only certain features were extracted from pattern data and analysis performed A major drawback of these methods arise when the classification result is unclear, and the original PD pattern cannot be correctly reconstructed from the extracted features Therefore, a need for the compact storage of patterns arises This is the first issue addressed in the thesis

The compact storage of PD patterns is achieved using the principles of fractal image compression and discussed in Chapter 3 This procedure eliminates the computationally intensive feature extraction from raw image The proposed fractal approach has an unique feature in which, physical position or regions in the input pattern are readily obtainable from the compressed data (comprising of transformations) This characteristic, unavailable in other compression methods, is utilized for feature extraction The fractal compression algorithm, very popular in areas of computer science, was suitably modified so as to be applicable to PD patterns This yielded higher compression ratios In addition to compressed storage, classification of different types of PD sources could also be implemented due to features being readily available in the compressed data The extracted features were tested for their classification abilities using a feedforward neural network Encouraging results have been obtained

The second issue is connected with processing of the acquired PD data for identification of the PD source Almost all the classification methods proposed till date, and some commercial PD instruments based on them, address the task of single source recognition only On the contrary, in on-site PD measurements it is quite likely that more than one PD source is simultaneously active Research in identification and discrimination of the constituent sources present in a multi-source PD pattern is still in its infancy and a solution is desirable A method is proposed to solve this problem

The second issue of multiple source PD classification is addressed in Chapter 4 A new method based on wavelet analysis i e multiresolution signal decomposition was proposed for this purpose This wavelet technique has a property of extracting the embedded horizontal, vertical and diagonal variations in an image in a separable form The usefulness of this aspect was exploited to identify individual PD sources present in a multi-source PD pattern Employing the Daubechies' wavelet, the PD patterns were decomposed up to the third level and suitable features were defined and extracted from these images The radial basis function neural network was used for testing the classification abilities of the extracted features More than 80 % of the patterns tested (not used during training) yielded correct classifications The tested inputs consisted of partially and completely overlapping PD patterns, and thus demonstrates the potential of the proposed method.

The data-base used consisted of PD patterns that were gathered from several experimental set-ups in different laboratories It is believed that this approach will yield a classification system that is robust and has good generalization abilities

Details of the proposed approaches, algorithms, classification results, along with discussion are presented in the thesis