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IMPROVED SVM AND ANN IN INCIPIENT FAULT DIAGNOSIS OF POWER TRANSFORMERS USING CLONAL SELECTION ALGORITHMS

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Abstract. *Based on statistical learning theory (SLT), the support vector machine (SVM) is well recognized as a powerful computational tool for problems with nonlinearity having high dimensionalities. Solving the problem of feature and kernel parameter selection is a difficult task in machine learning and of high practical relevance in blurred fault diagnosis. We explored the feasibility of applying an artificial neural network (ANN) and multi-layer SVM with feature and radial basis function (RBF) kernel parameter selection to diagnose incipient fault in power transformers by combining a clonal selection algorithm (CSA). Experimental results of practical data demonstrate the effectiveness and improved efficiency of the proposed approach, quickens operations, and also increases the accuracy of the classification.*

Keywords: SVM, Incipient fault, Diagnosis, Power transformer, Clonal selection algorithm

1. **Introduction.** Studies over the past decades have demonstrated the dissolved gases in oil are closely related to internal faults. A long in-service transformer is subject to electrical and thermal stresses; which may degrade the oil inside. Accompanying the degradations of power transformers, different gas concentrations are released in the oil, which can be used to identify incipient faults [1-4]. The most widely used method for detecting incipient faults is based on dissolved gas analysis (DGA), which detects degradations in the transformer oil and insulating materials before transformer failure. According to the IEC Publication 599/IEEE C57 [5,6], these degradations produce fault-related gases such as hydrogen (H_2), oxygen (O_2), nitrogen (N_2), methane (CH_4), ethylene (C_2H_4), acetylene (C_2H_2), ethane (C_2H_6), carbon dioxide (CO_2), and carbon monoxide (CO), all of which can be detected in a DGA test. The existence of these gases means corona or partial discharge, thermal heating, and arcing may occur [1]. The associated energy dissipation is least in corona or partial discharge, medium in thermal heating, and highest in arcing [4]. The IEC Publication 599/IEEE C57 criteria [6] using three relative ratios of characteristic gases as the variables for interpretation are shown in Tables 1 and 2.

Various fault diagnosis methods have been developed based on the principle of DGA, but no single technique can achieve consistent results. Each method has its advantages and disadvantages. For example, the drawback of the key gas and ratio methods is their fault diagnosis using DGA data may vary for different utilities and therefore no general