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PRICE PREDICTIVE ANALYSIS MECHANISM UTILIZING GREY WOLF OPTIMIZER-LEAST SQUARES SUPPORT VECTOR MACHINES

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ABSTRACT

A good selection of Least Squares Support Vector Machines (LSSVM) hyper-parameters' value is crucial in order to obtain a promising generalization on the unseen data. Any inappropriate value set to the hyper parameters would directly demote the prediction performance of LSSVM. In this regard, this study proposes a hybridization of LSSVM with a new Swarm Intelligence (SI) algorithm namely, Grey Wolf Optimizer (GWO). With such hybridization, the hyper-parameters of interest are automatically optimized by the GWO. The performance of GWO-LSSVM is realized in predictive analysis of gold price and measured based on two indices viz. Mean Absolute Percentage Error (MAPE) and Root Mean Square Error (RMSPE). Findings of the study suggested that the GWO-LSSVM possess lower prediction error rate as compared to three comparable algorithms which includes hybridization models of LSSVM and Evolutionary Computation (EC) algorithms.

Keywords: gold price predictive analysis, grey wolf optimizer, least square support vector machines.

INTRODUCTION

The unpredictability of gold price in recent years has attracted much attention from many parties which includes commodities traders, mining companies, investors and academia as well. Govern by high nonlinearity features, the price of gold has experienced an expeditious increases during the last several years [1] and is continually predicted to be on steady condition in 2015 [2]. Nonetheless, to accurately predict the price of gold is such a great challenge. With the uncertainties of world economic and surrounded by various factors, this challenge has paved a positive way for academic community in exploring a new method for predictive analysis purposes.

In literature, the application of well-known machine learning algorithm, namely Artificial Neural Network (ANN) has been proposed for the said task and this includes for gold price [3, 4]. Nonetheless, the adaptation of Empirical Risk Minimization (ERM) which tends to minimize the training error rather than the true error makes the ANN suffer with over fitting problem [5]. Recently, the emergence of Statistical Learning Theory based algorithm, viz. Least Squares Support Vector Machines (LSSVM) [6] has been a rival to the ANN. As opposed to ANN, LSSVM which is a modification version of Support Vector Machines (SVM) [7] adopted Structural Risk Minimization (SRM) principle which minimizes the generalization error instead of training error [8]. Hence, promising generalization can be obtained.

Owing to its remarkable nonlinear mapping capabilities, LSSVM has been proven to contribute a significant impact in solving various data mining tasks which includes prediction, classification and many others [9, 10]. However, despite its diversity in application, it is well documented that the generalization performance of LSSVM is highly dependent on the value of its two free hyper-parameters, namely regularization parameter, γ and kernel parameter, $\sigma 2$ [11]. Any improper value set to the hyper parameters would result in undesired generalization performance.

An extensive literature reviews reveals that a good numbers of meta-heuristic algorithms have been proposed in order to cater this matter. In [11-13], the LSSVM is hybrid with a Swarm Intelligence (SI) algorithm, namely Particle Swarm Optimization (PSO) for parameter tuning. In the studies, the efficiency of PSO-LSSVM is realized in different problem domain which includes nuclear science, shipping and water drainage and irrigation respectively. On the other hand, the capability of Genetic Algorithm (GA), which is a dominant algorithm in Evolutionary Algorithm (EA) class was tested in several function estimation problems, which includes in [14, 15]. Meanwhile, in [16], the LSSVM is hybridized with Fruit Fly Optimization (FFO) [17] for electric load predictive analysis. In the study, the FFO which is inspired from the food searching behaviour is employed as an optimizer to LSSVM. Later, the FFO-LSSVM is compared against several identified techniques which include single LSSVM and regression technique. Final results suggested that the FFO-LSSVM is capable to produce lower error rate relative to several identified metrics.

With respect to that matter, in this study, the LSSVM is optimized utilizing a new SI algorithm, namely Grey Wolf Optimizer (GWO) [18] which was originally inspired by the collective behaviour of grey wolf. This algorithm has been proven to be competitive to the existing meta-heuristic algorithms which include the PSO, GSA, Differential Evolution (DE), Evolutionary Programming (EP) and Evolution Strategy (ES) [18]. With such an impressive performance, in this study, the GWO is