Project Number:

Department of Communication Systems

Project Title: Adaptive filters-based intelligent Sensors for quality prediction in oil refineries

Degree Scheme for which the project is applicable:

DSP ☑ PMRC ☑ SSC ☑

Industrial Support: Yes ☑ No ☐

First Supervisor: Dr. P Angelov Second Supervisor: Mr. X. Zhou

Project Description:

This project will focus on a practical problem formulated by the company CEPSA, Spain which runs oil refineries in Tenerfie. The company is interested in advanced signal processing for automatic and real-time monitoring and prediction of the quality of the product of an oil refinery based in Tenerife island of Spain. The research will aim to study and develop methods based on Adaptive filters, RLS, Kalman filters and recent results in evolving fuzzy rule-based systems. The student will work with real industrial data concerning temperatures, pressures etc. parameters of a real industrial process. The student will then move on to look at methods of predicting the quality of the product using these same signals.

Prediction of the properties of the crude oil distillation based on statistical methods and laboratory-based analysis has been around for decades. However, there are still many problems with the existing estimators that require a development of new techniques especially for an on-line analysis of the quality of the distillation process. The nature of non-linear characteristics of the refinery process, the variety of properties to measure and control and the narrow window that normally refinery processes operates in are only some of the problems that a prediction technique should deal with in order to be useful for a practical application. There are many successful application cases that refinery units use real plant data to calibrate models. They can be used to predict quality properties of the gas oil, naphtha, kerosene and other products of a crude oil distillation tower. Some of these are distillation end points and cold properties (freeze, cloud). However, it is difficult to identify, control or compensate the dynamic process behaviour and the errors from instrumentation for an online model prediction. The objective of this work is to study different adaptive filters and some advanced tools for real-time prediction and online monitoring of these properties of the refinery distillation process.

This work is novel, and is of interest to the company CEPSA and may lead to a research publication subject to good results.

Skills required: Adaptive filters, RLS, Kalman filter, programming in Matlab or C

References:

[1] Macias, J., P. Angelov, X. Zhou, Predicting Quality of the Crude Oil Distillation using Evolving Takagi-Sugeno Fuzzy Models, *In Proc. 2006 International Symposium on Evolving Fuzzy Systems*, 7-9 September, 2006, Ambelside, Lake District, UK, IEEE Press, pp. 201-207, ISBN 0-7803-9719-3, *'best industry-related paper' runner up award*

[2] Angelov, P., D. Filev, An Approach to Online Identification of Takagi-Sugeno Fuzzy Models, *IEEE Trans. on Systems, Man, and Cybernetics*, part B – Cybernetics, v.34 (1), pp. 484-498, 2004.

Supervisor Signature…….

Student Signature…….