

NOTES FOR THE AUSTRALIAN REFINERY DATA SET

The process

The data are from an Australian refinery separation unit shown in Figure 1. Figure 2 plots the data set showing the steam flow, analyser and temperature measurements (PV) and set points (SP), controller outputs (OP) and also the controller errors (SP-PV). Measurements from upstream and downstream pressure controllers PC1 and PC2 are also included. The sampling interval was 20s. The data set includes some set point changes and evidence of non-stationary low frequency trends.

The data set was analysed in [1] and [2]. It is known that there was a faulty steam sensor in the steam flow loop FC1. It was an orifice plate flow meter but there was no weep-hole in the plate which had the effect that condensate collected on the upstream side until it reached a critical level, and the accumulated liquid would then periodically clear itself by siphoning through the orifice. The challenge for the analysis of this unit is to verify that the faulty steam flow loop is the root cause of the disturbance.

A second disturbance is also present in PC1 and PC2 whose root cause is not known for sure. It is likely to be due to a controller interaction between the two pressure loops. A full worked analysis and diagnosis of the sources of disturbances in this data set is published in [1]. An analysis of samples 580 to 1081 of this data set is reported in [2]

The supplied data

The data plotted in Figure 2 are supplied electronically in the Matlab data file called **AustralianRefineryDatasetFromNFThornhill_Data.mat**. The PV and OP are *mean centred* and *normalized to unit standard deviation*. The ERR is (SP-PV) and has also been mean centered and normalized. The normalized value of ERR is not mathematically equal to (normalized SP – normalized PV) because the means and standard deviations of PV and SP might be different.

variable name	columns	sampling interval
AC1	Column 1 – PV (measured variable)	20 seconds
	Column 2 – SP (set point)	
	Column 3 – OP (controller output)	
	Column 4 – ERR (SP-PV, then normalized)	
FC1	Column 1 – PV (measured variable)	20 seconds
	Column 2 – SP (set point)	
	Column 3 – OP (controller output).	
	Column 4 – ERR (SP-PV, then normalized)	
PC1	Column 1 – PV (measured variable)	20 seconds
	Column 2 – SP (set point)	
	Column 3 – OP (controller output).	
	Column 4 – ERR (SP-PV, then normalized)	
PC2	Column 1 – PV (measured variable)	20 seconds
	Column 2 – SP (set point)	
	Column 3 – OP (controller output).	
	Column 4 – ERR (SP-PV, then normalized)	
TC1	Column 1 – PV (measured variable)	20 seconds
	Column 2 – SP (set point)	
	Column 3 – OP (controller output).	
	Column 4 – ERR (SP-PV, then normalized)	

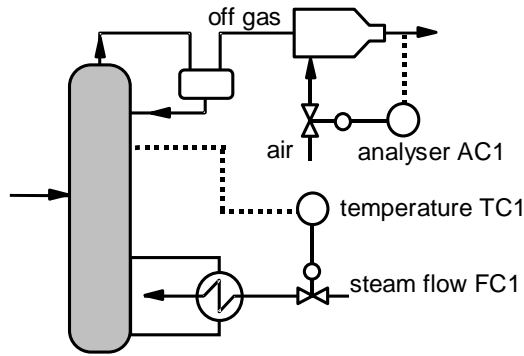


Figure 1. Refinery separation unit showing the locations of temperature, flow and composition control loops. Upstream and downstream pressure control loops PC1 and PC2 are not shown.

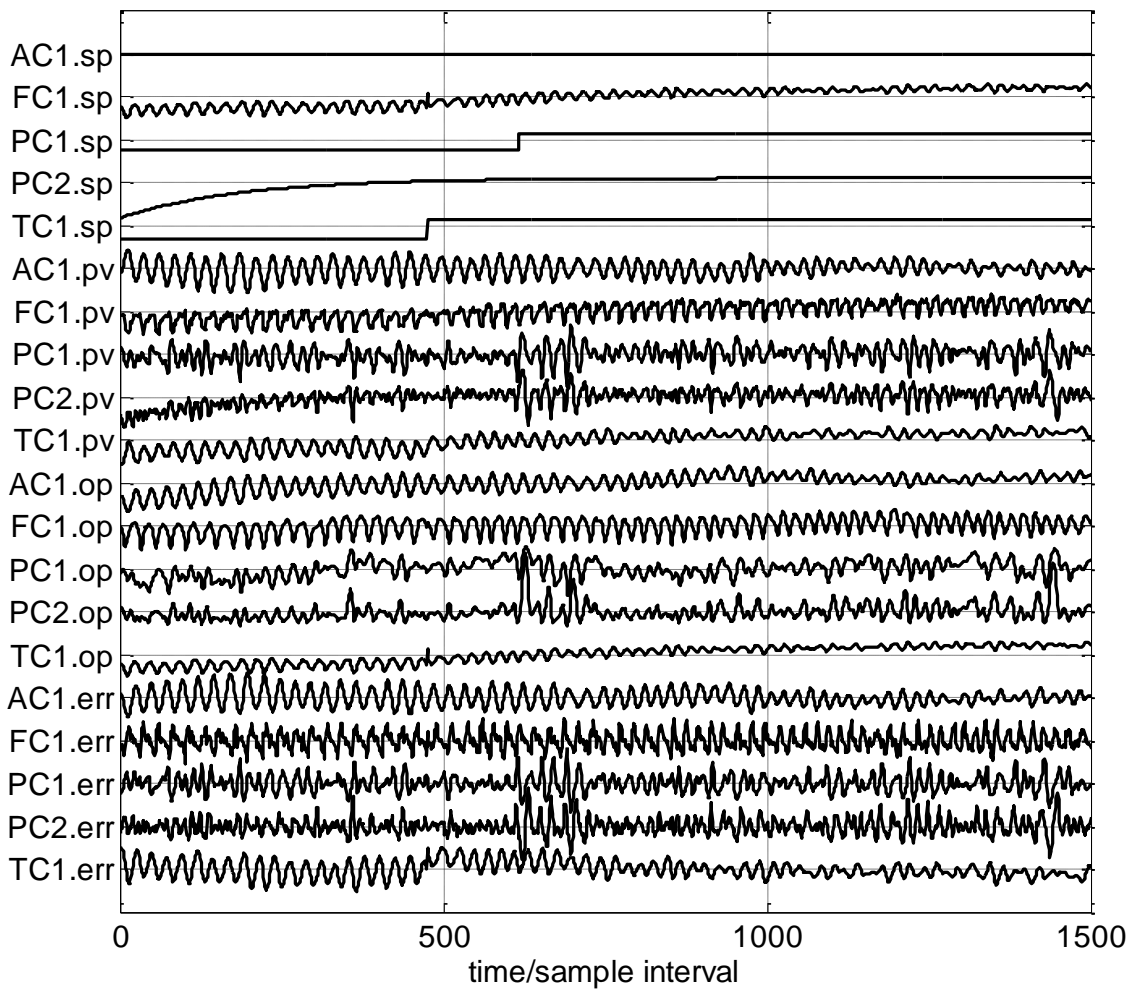


Figure 2. Data set from the refinery separation unit. The sampling interval is 20s.

Reference:

- [1] Thornhill, N.F., 2007, Locating the source of a disturbance, In *Process Control Performance Assessment; From Theory to Implementation*, Chapter 6, Eds: D.O. Uduehi, A. Ordys and M.A. Johnson, Springer-Verlag (London) Ltd, ISBN 1846286239.
- [2] Thornhill, N.F. and Horch, A., 2007, Advances and new directions in plant-wide disturbance detection and diagnosis, *Control Engineering Practice*, 15, 1196–1206.