PLACKETT BURMAN DESIGN

A popular class of screening designs is the Plackett-Burman design (PBD), developed by R.L. Plackett and J.P. Burman in 1946. It was designed to improve the quality control process that could be used to study the effects of design parameters on the system state so that intelligent decisions can be made. Plackett and Burman (PB) devised orthogonal arrays are useful for screening, which yield unbiased estimates of all main effects in the smallest design possible. Various number or 'n' factors can be screened in an 'n + 1' run PB design. Useful for fitting first-order models (which detect linear effects) and can provide information on the existence of second-order effects (curvature) when the design includes centre points

A characteristic feature is that the sample size is a multiple of four rather than a power of two (4k observations with k = 1, 2,……n). PB designs are used to investigate n–1 variables in n experiments proposing experimental designs for more than seven factors and especially for n × 4 experiments, i.e., 8, 12, 16, 20, etc., that are suitable for studying up to 7, 11, 15, 19, etc., factors respectively.

John T and Oddgeir S discusses about a new approach to 12 run Plackett Burman design Under the assumption of effect sparsity. It is demonstrated that very structured alias pattern leads to a new interpretation of half normal plots, and the good projection properties may be exploited in searching for active factors.

` Diane L.B Douglus M H presented a method for sensitivity analysis of a simulation model. In their work, the Plackett–Burman technique allows the concurrent consideration of numerous parameters. The required number of model scenarios is reduces with the application of Plackett Burman method.

Jonas Asprion, Oscar Chinellato, Lino Guzzella presented a model which has the advantages of both empirical modelling and phenomenological modelling. The former are fast and quantitatively accurate in the identified region, but lack the generality and extrapolation capability of the latter. The model presented in this work combines the advantages of both model types and thus complies with typical requirements of computationally intensive fields such as dynamic optimisation and model-based control. This unique aggregation of features is achieved by extracting the most relevant physical phenomena and extending them by physically motivated empirical elements.

Saravanan Duraiarasan, Rasoul Salehi, Anna Stefanopoulou, in their work presented a a physics-based control oriented NOx model to estimate the feedgas NOx for a diesel engine. This cycle averaged NOx model is able to capture the impact of all major diesel engine control variables including the fuel injection timing, injection pressure, and injection rate, as well as the effect of cylinder charge dilution and intake pressure on the emissions. The model accuracy was validated by experimental data and a maximum error of only 6.2% was observed with changes in engine control parameters from the nominal value.

CONSTRUCTION:

The first step in a screening design is selecting the factors, defining their levels and responses which have to be measured. The choice of factors depends on the user.

Second step is the generation of design matrix. Plackett Burman Screening Design (PBSD) is used to indicate two level fractional factorials, although more levels are possible. It allows efficient estimation of main effects of all factors being explored.

The columns represent factors with degrees of freedom equal to the number of levels in the column. The elements in the columns specify the levels high level (+1) and low level (−1) to be set for factors for the given experiment. The rows in the matrix contain the process run. Out of these runs, their effect on the variable can be studied. The number of runs goes down columns. The post processing of results and the main effect of interaction can be determined. Any variable having an effect on another variable can be used.

Table 2.1 Example of a 12-run Plackett Burman design

Trial	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11
1	+	−	+	−	−	−	+	+	+	−	+
2	+	+	−	+	−	−	−	+	+	+	−
3	−	+	+	−	+	−	−	−	+	+	+
4	+	−	+	+	−	+	−	−	−	+	+
5	+	+	−	+	+	−	+	−	−	−	+
6	+	+	+	−	+	+	−	+	−	−	−
7	−	+	+	+	−	+	+	−	+	−	−
8	−	−	+	+	+	−	+	+	−	+	−
9	−	−	−	+	+	+	−	+	+	−	+
10	+	−	−	−	+	+	+	−	+	+	−
11	−	+	−	−	−	+	+	+	−	+	+
12	−	−	−	−	−	−	−	−	−	−	−