
November 28, 2024

Series 8: Identifying a design

Objective

The objective of this exercise is to train the analysis of a design before and after the measurement. A by-product is the competence about plotting data, fitting models, producing ANOVA tables, performing a canonical analysis.

A the level of Matlab the following specific functions are potentially of interest: `readtable()`, `convhull()`, `num2str()`, `imagesc()`, `doehlert()`, `ccdesign()`, `x2fx()`, `corrcoef()`, `normplot()`, `delete()`, `fitlm()`, `stepwiselm()`, `anova()`, `slice()`, `patch()`, `isosurface()`.

1 Surface energy in a thin layer on a disk of silicium

Table 1 reproduces data of a set of experiments related to the deposit of a thin layer on a disk of silicon.

1. Realize a *scatter plot* of the variables two by two to visualize the geometry of the design and identify it.
2. Check what type of models could be fitted with this data.
3. Built a model matrix for a quadratic model and determine the statistical quality of the design in reference to the quadratic model (optional: perform a comparison with a composite design)
4. Infer the coefficients for a quadratic model
5. Identify the significant effects
6. Perform an ANOVA
7. Perform a canonical analysis

Table 1: Data

	C_2H_2	CO_2	Pressure	Power	Surface energy
	[<i>sccm</i>]	[<i>sccm</i>]	[μ <i>bar</i>]	[<i>w</i>]	[<i>mN/m</i>]
min	10	10	5	100	
max	30	16	35	200	
I	x_1	x_2	x_3	x_4	y
1	20	13.00	20.00	150.00	51.74
2	10	13.00	20.00	150.00	51.46
3	30	13.00	20.00	150.00	51.22
4	15	10.40	20.00	150.00	51.72
5	25	15.60	20.00	150.00	46.07
6	15	15.60	20.00	150.00	45.89
7	25	10.40	20.00	150.00	51.72
8	15	12.13	7.75	150.00	52.33
9	25	13.87	32.25	150.00	45.83
10	15	13.87	32.25	150.00	48.83
11	20	11.27	32.25	150.00	49.90
12	25	12.13	7.75	150.00	55.76
13	20	14.73	7.75	150.00	49.27
14	15	12.13	16.94	110.47	49.48
15	25	13.87	23.06	189.53	46.35
16	15	13.87	23.06	189.53	46.19
17	20	11.27	23.06	189.53	48.83
18	20	13.00	10.81	189.53	47.95
19	25	12.13	16.94	110.47	48.18
20	20	14.73	16.94	110.47	46.04
21	20	13.00	29.19	110.47	44.30
22	20	13.00	20.00	150.00	50.56
23	20	13.00	20.00	150.00	49.87