Supplementary Materials

Digitised Optimisation of Nanoparticle Synthesis via Laser Ablation: An Industry 4.0 Multivariate Approach for Enhanced Production

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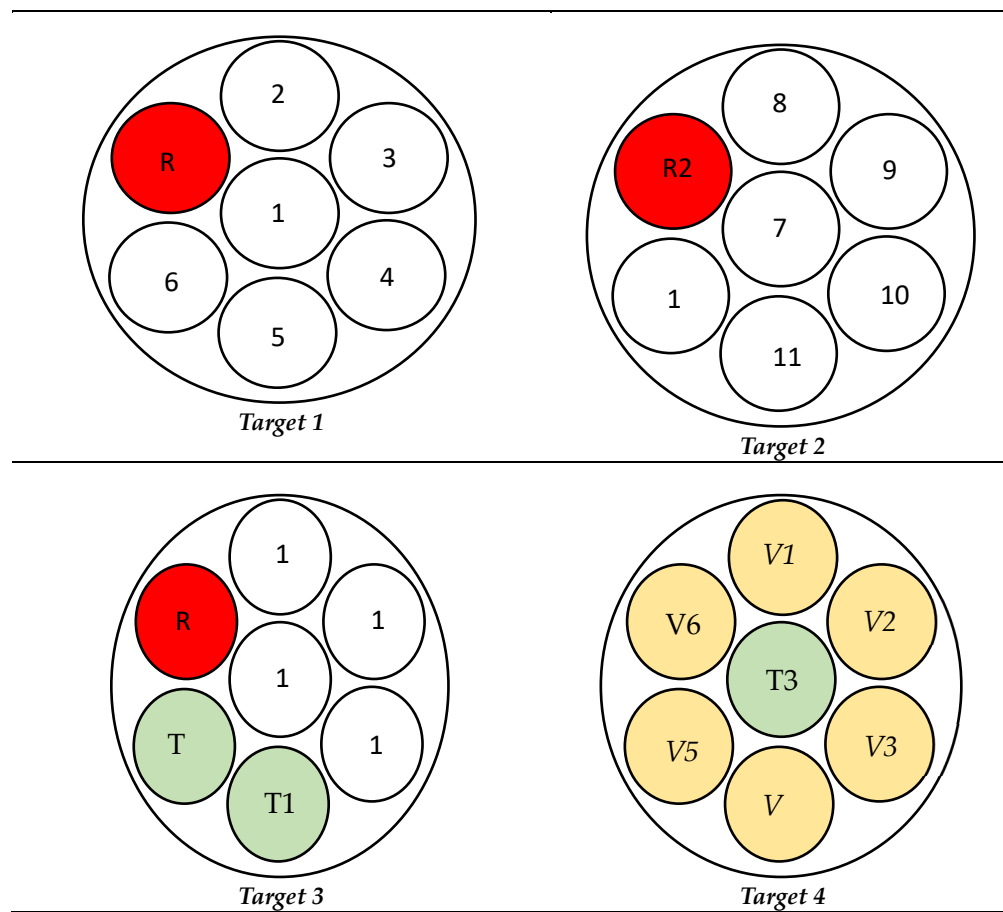
* Correspondence: brian.freeland@dcu.ie

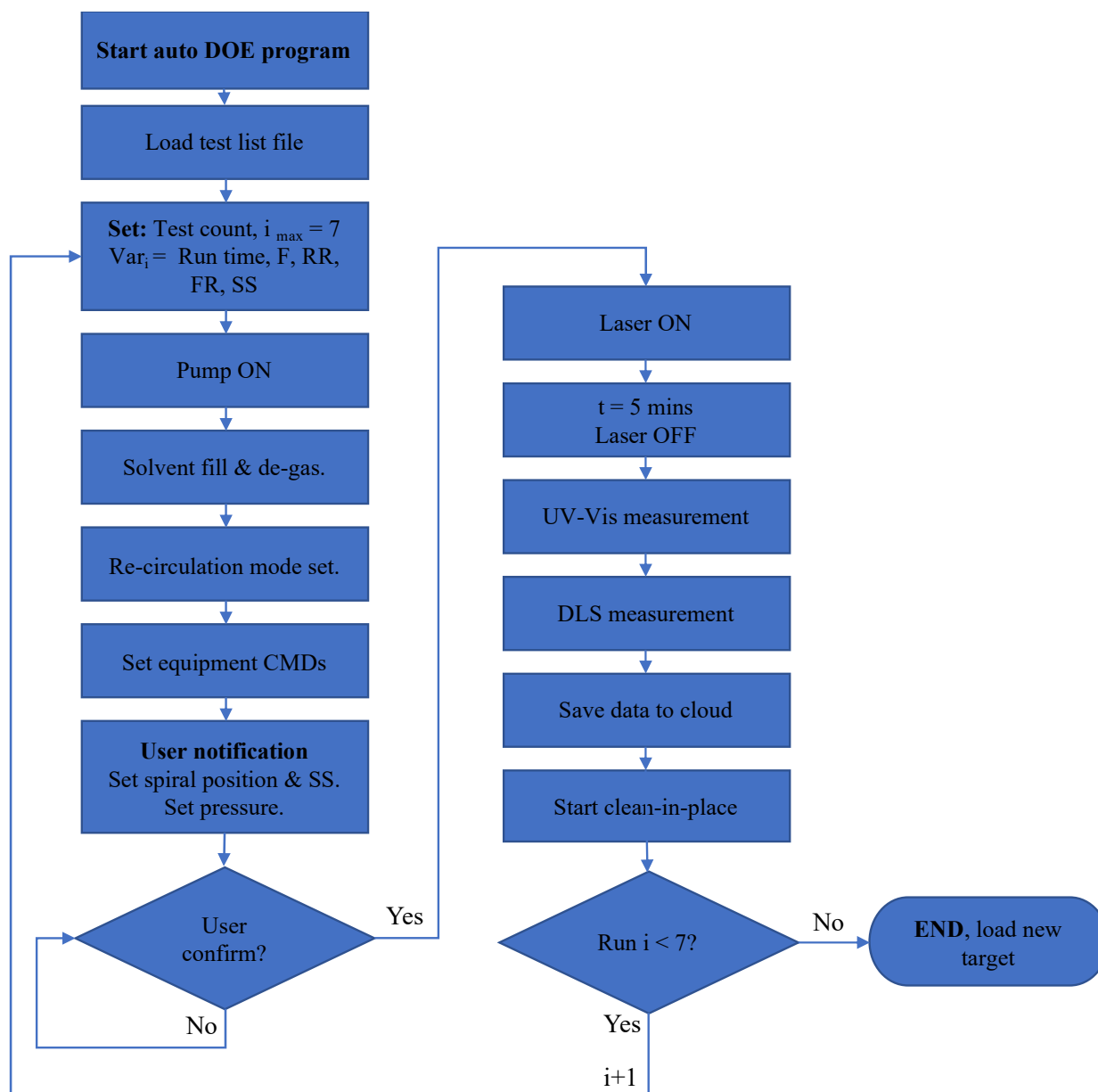**Figure S1.** Spiral placement on targets 1 - 4, for Taguchi DOE.

Start auto DOE program

↓

Load test list file

↓

Set: Test count, $i_{max} = 7$
$Var_i = $ Run time, F, RR,
FR, SS

↓

Pump ON

↓

Solvent fill & de-gas.

↓

Re-circulation mode set.

↓

Set equipment CMDs

↓

User notification
Set spiral position & SS.
Set pressure.

↓

User confirm? —Yes→

No → (loop back)

Laser ON

↓

t = 5 mins
Laser OFF

↓

UV-Vis measurement

↓

DLS measurement

↓

Save data to cloud

↓

Start clean-in-place

↓

Run i < 7? —No→ **END**, load new target

Yes
i+1

Figure S2. Flow chart of semi-automatic DOE program.

Table S1. Example of automatic experiment table loaded into the automatic LASiS test software.

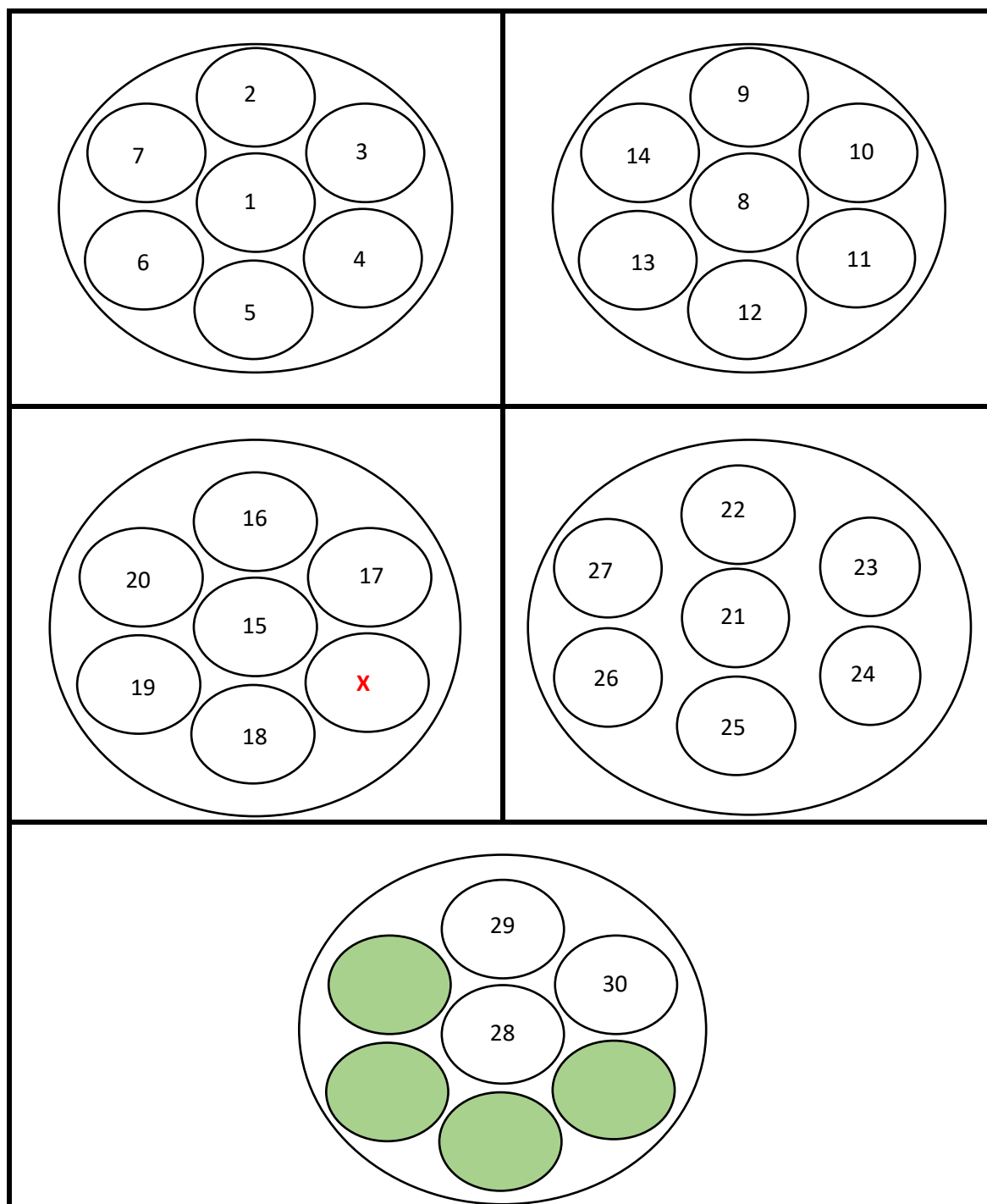| Step	Run time (min)	Laser Power (%)	Rep rate (Hz)	Period (micro S)	Pump Flowrate (rpm)	DLS meas (Y/N)	Uv meas (Y/N)	Ablation state	SetZero dls	Baseline uv
1	5	50	10000	3.5	20	y	y	Recycle	y	y
2	5	70	20000	3.5	45	y	y	Flow-through	y	y
3	5	66	30000	3.5	50	y	y	Recycle	y	y
4	5	82	40000	3.5	77	y	y	Recycle	y	y
5	5	46	50000	3.5	15	y	y	Recycle	y	y
6	5	100	11000	3.5	23	y	y	Recycle	y	y
7	5	94	10000	3.5	82	y	y	Recycle	y	y

Figure S3. Full-factorial experiments target layout.
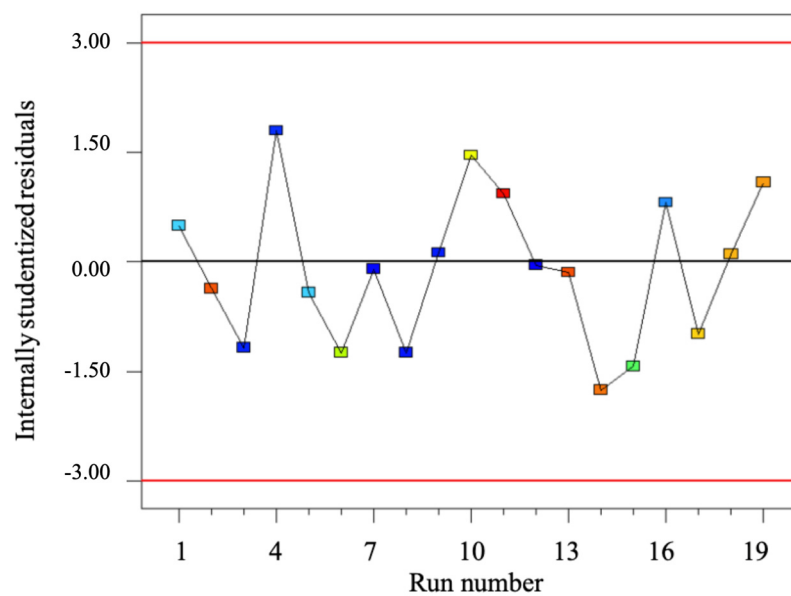
Figure S4. Plot of residuals vs run number for Taguchi colloid absorption modelling.
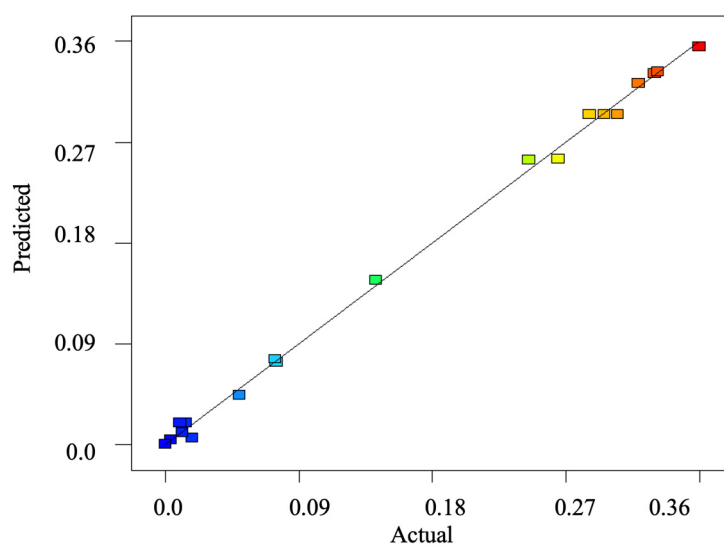

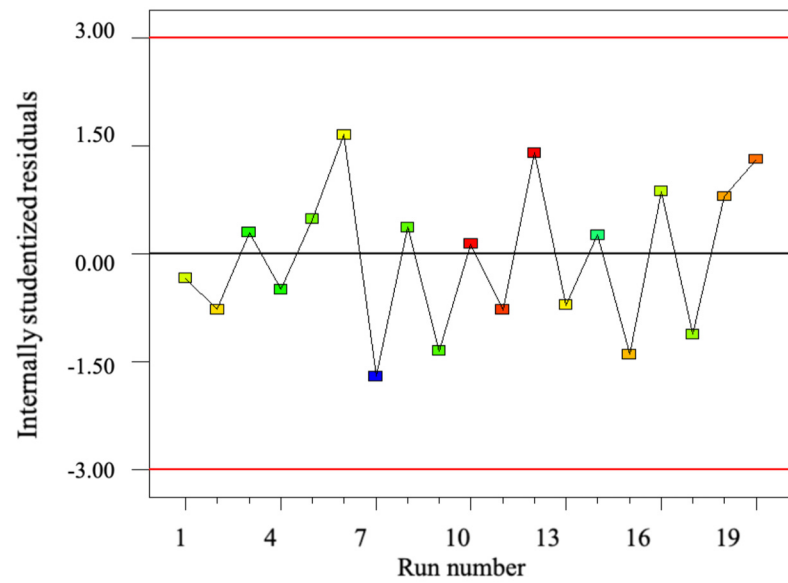**Figure S5.** Plot of model prediction vs experimental absorbance values (A.U.) for Taguchi colloid absorption modelling.

Figure S6. Chart of residuals vs run number for at-line nano colloid size modelling.
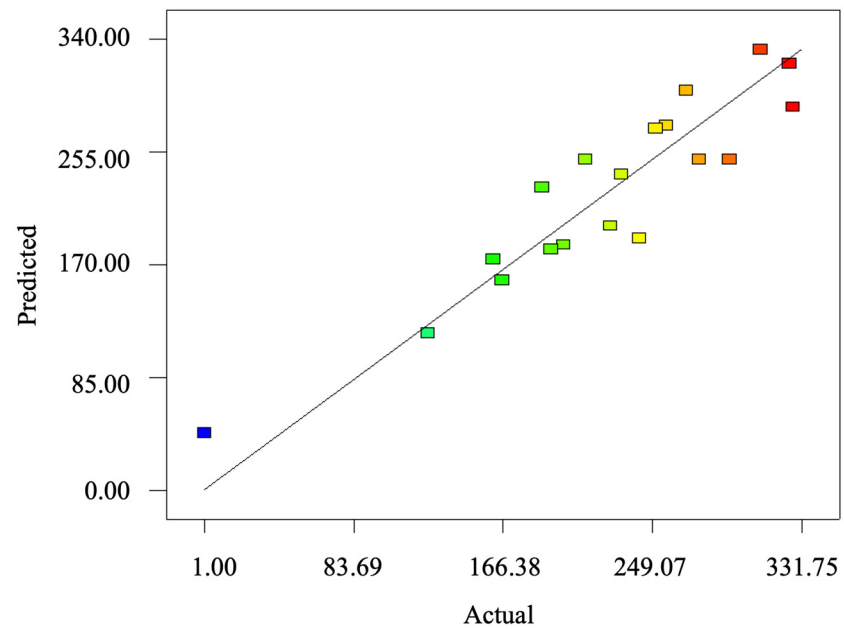

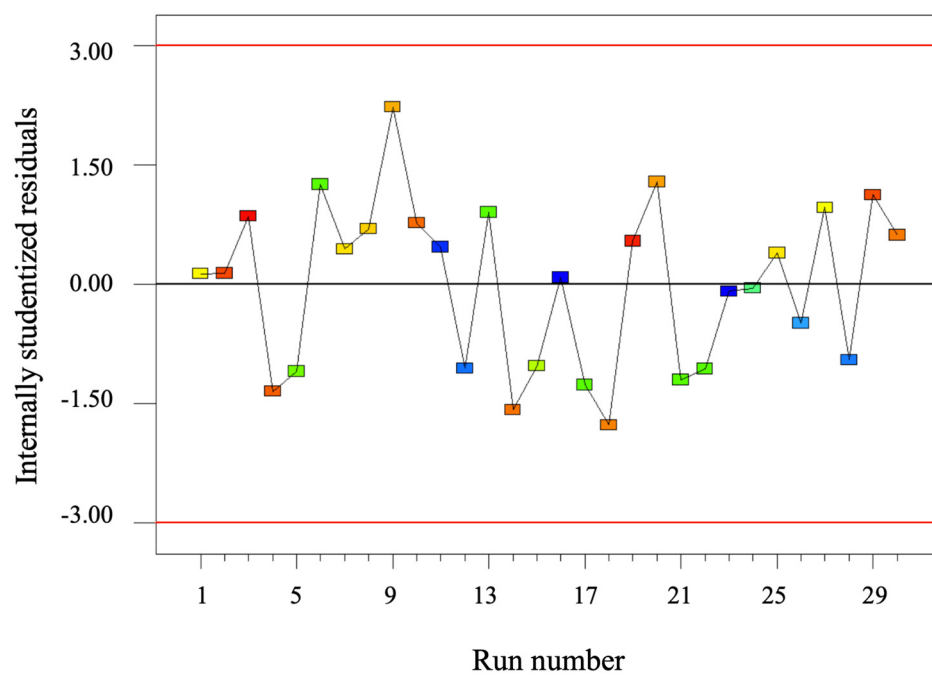**Figure S7.** Plot of model predicted size vs experimental size measurement.

Figure S8. Chart of residuals vs run number FFD colloid absorption modelling.