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SOLAR THERMAL ENERGY RESEARCH GROUP

Heliostat field layout optimization for central receiver systems

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Central Receiver System
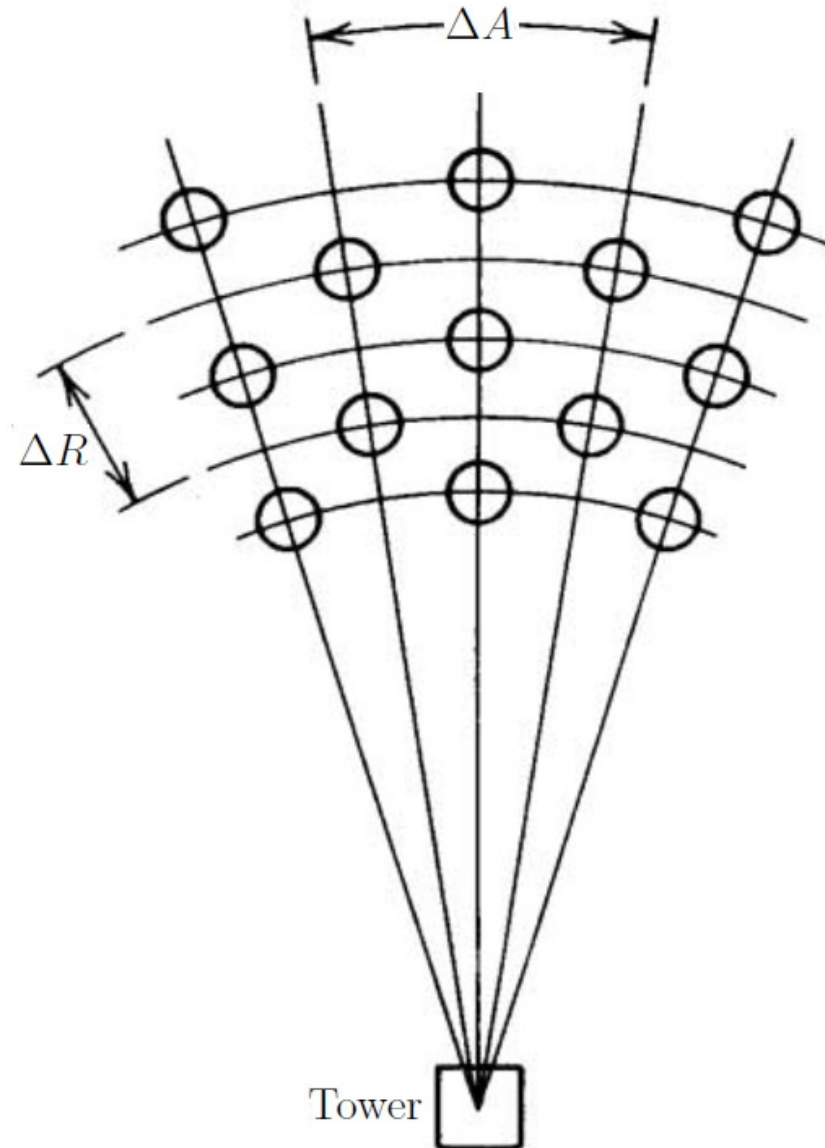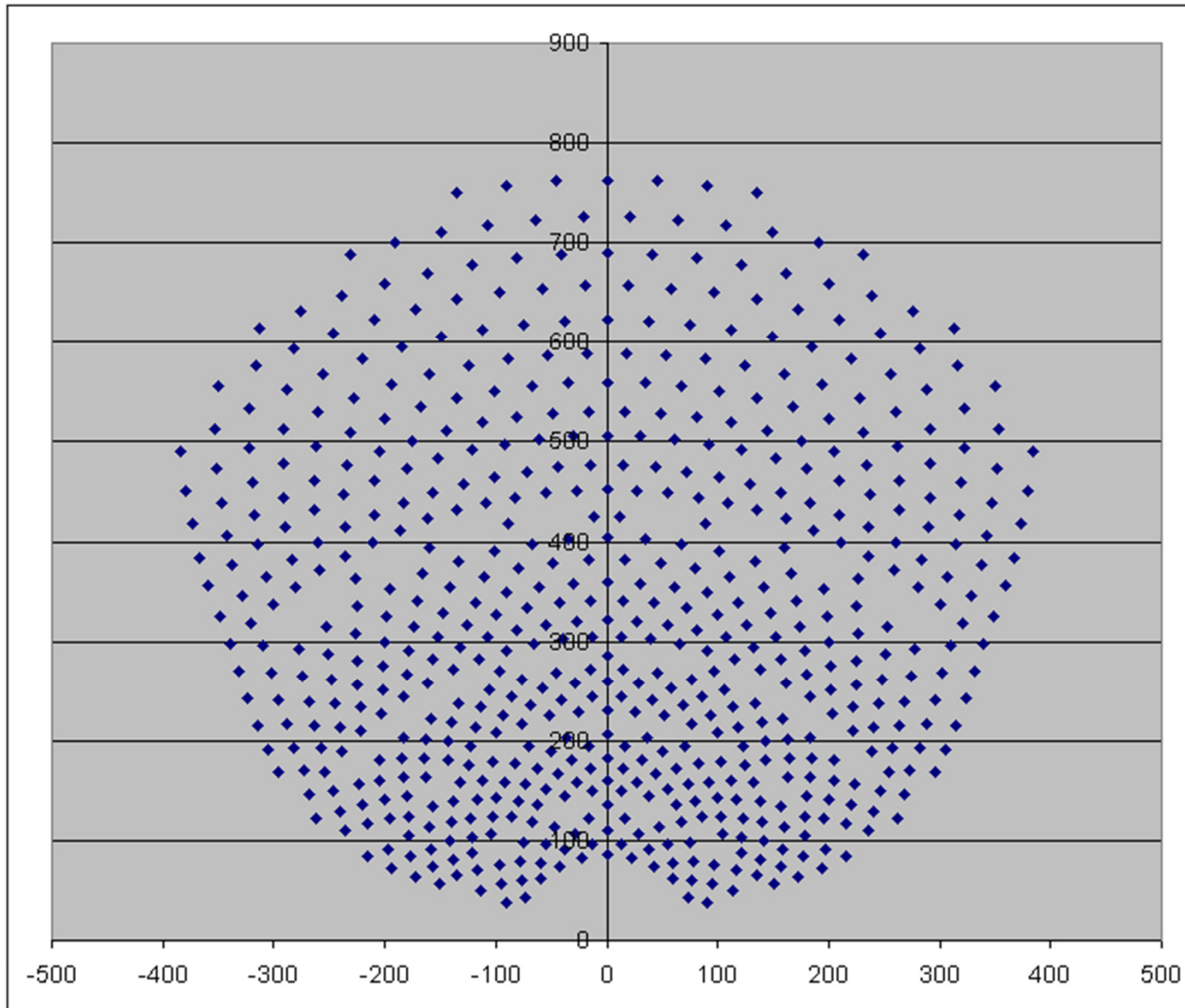

SOLAR TWO - MOJAVE DESERT, CALIFORNIA

Objective

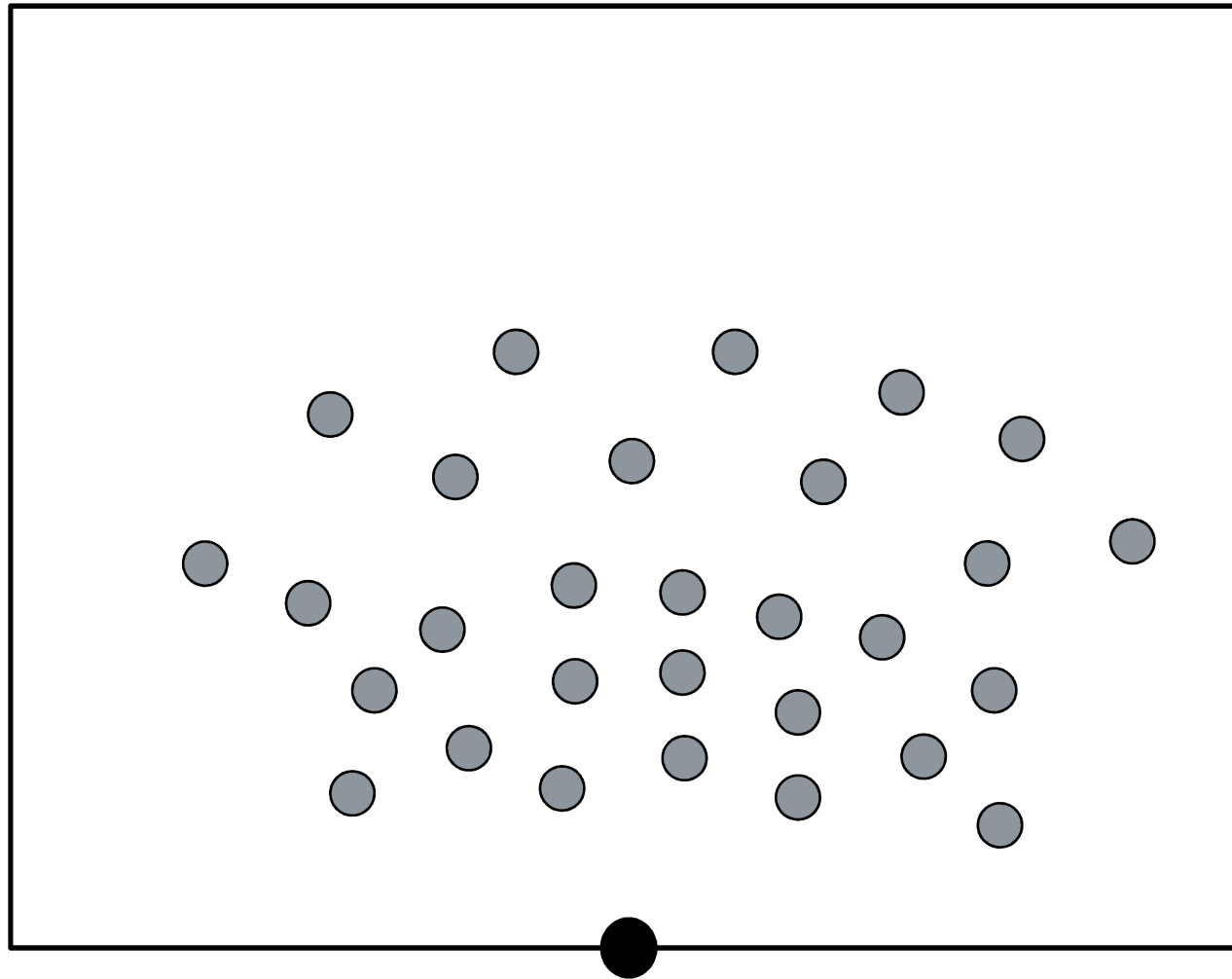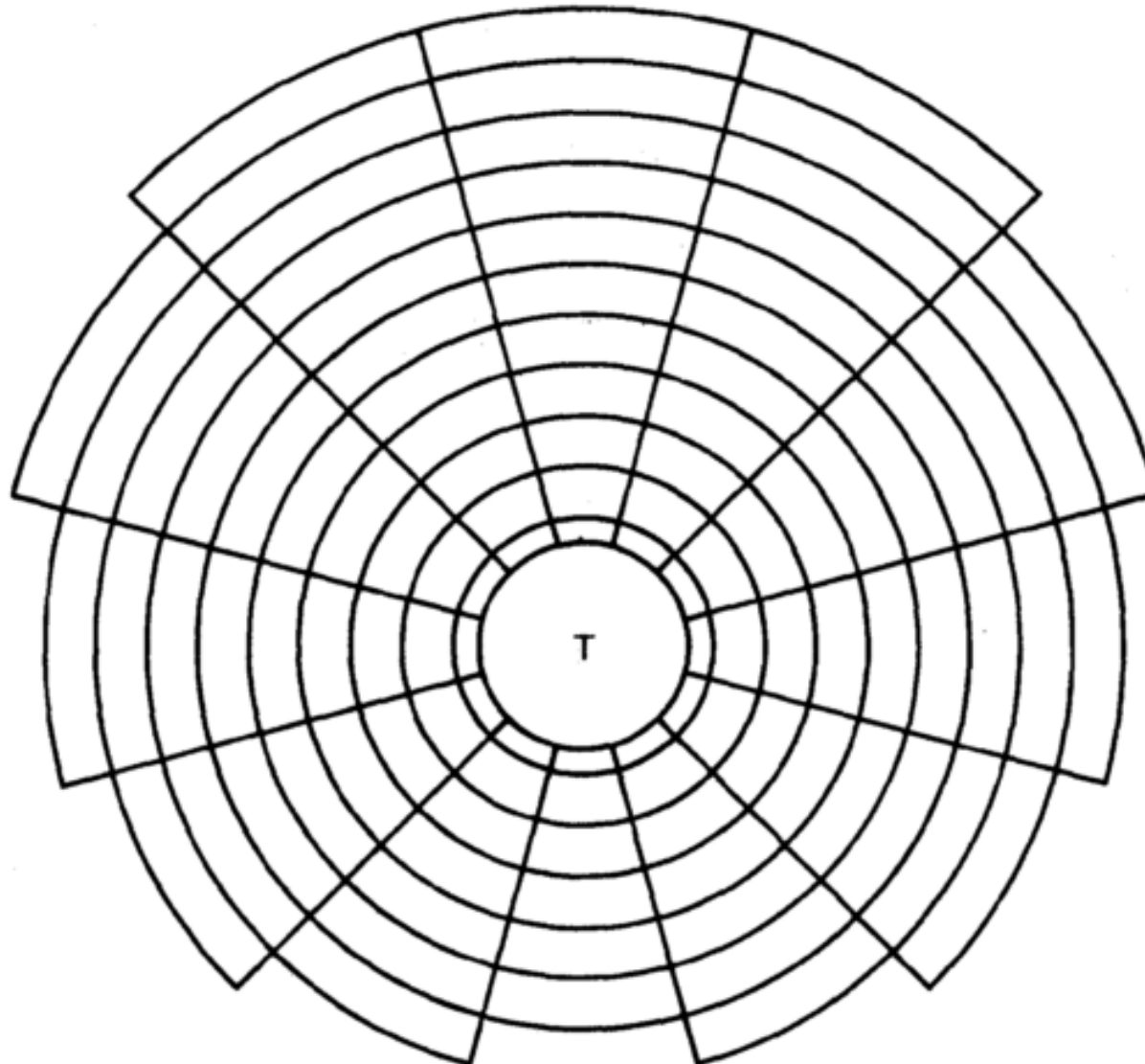# Methods of Optimisation - Pattern

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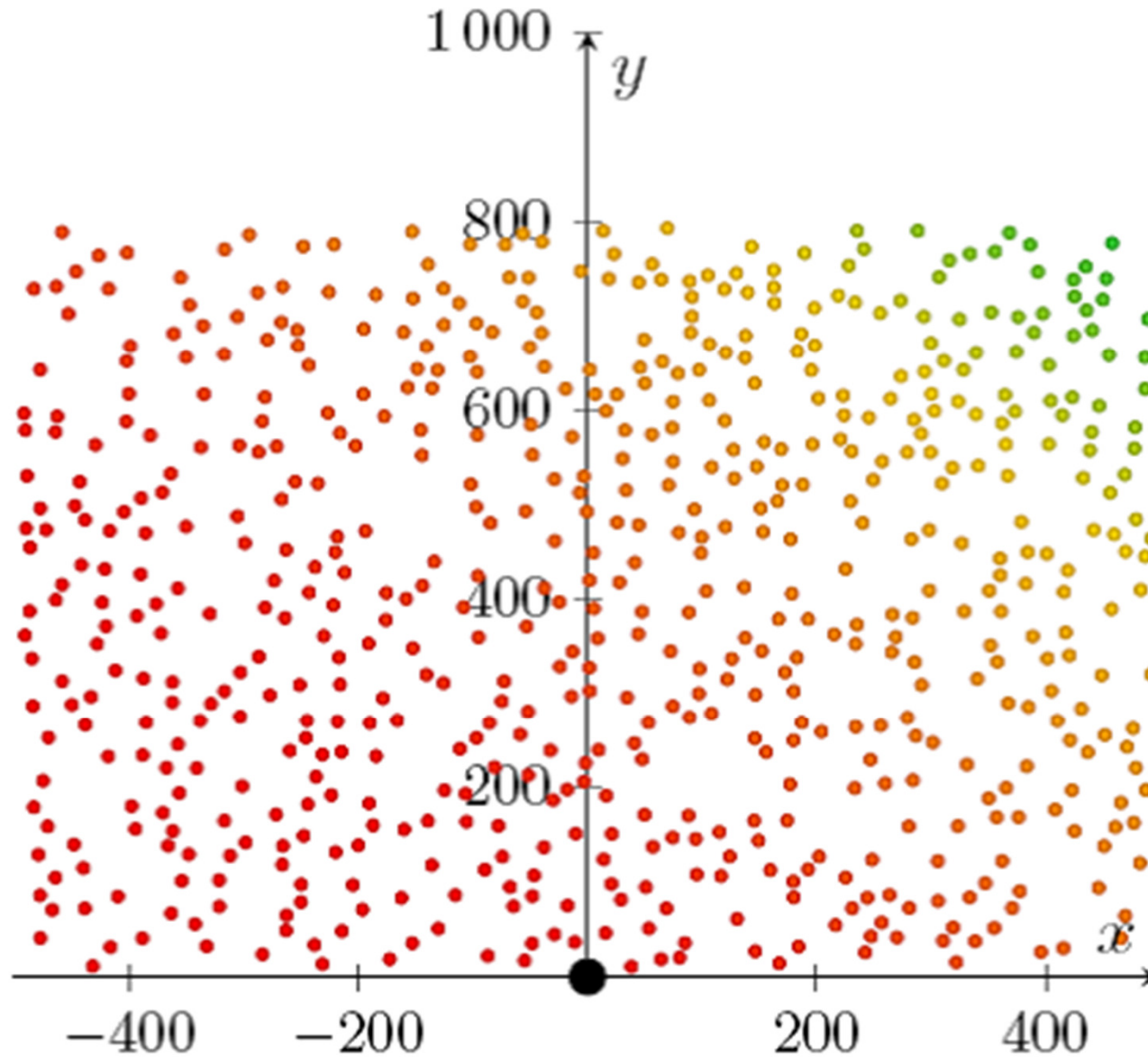
Methods of Optimisation – Growth Method

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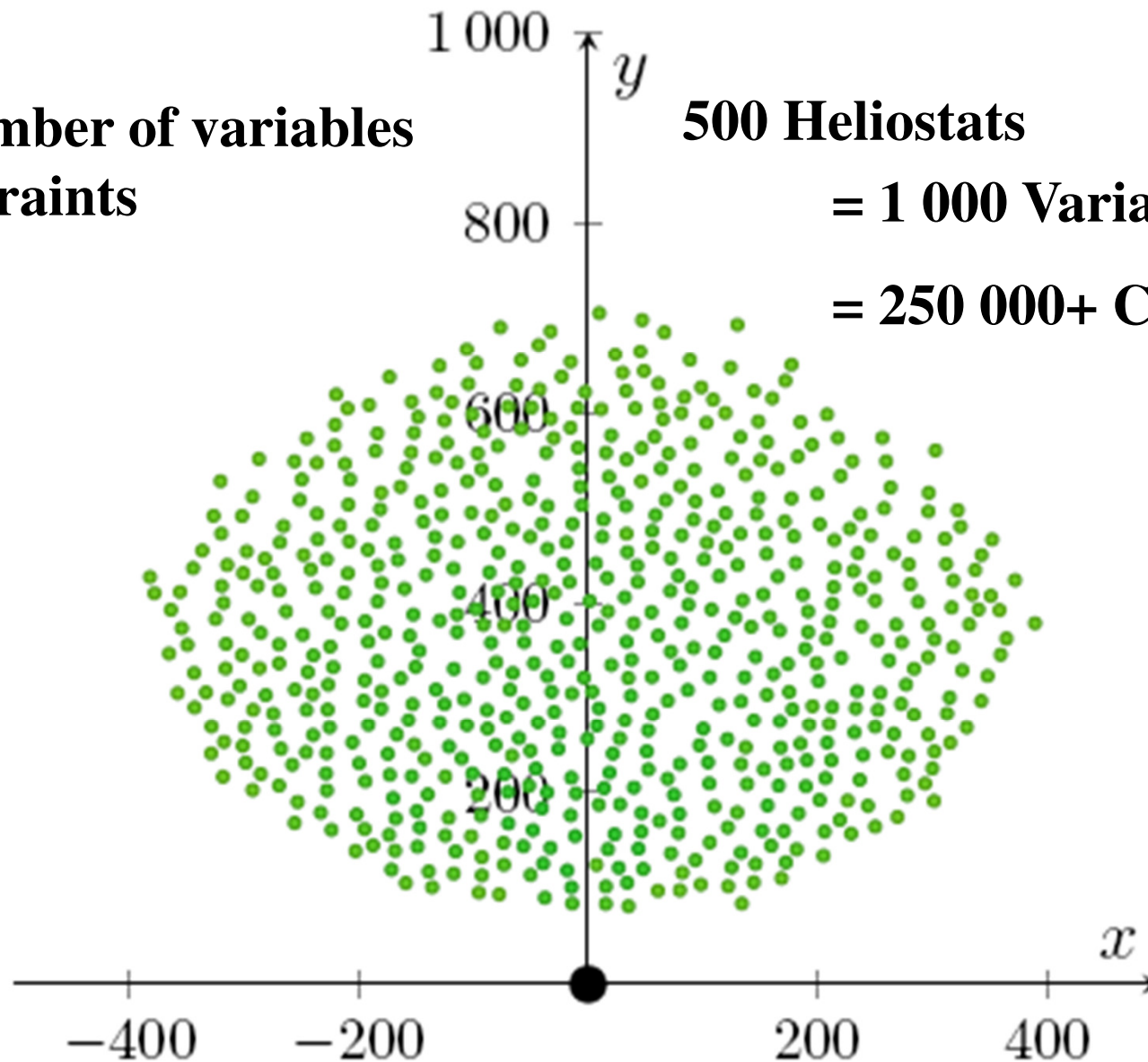
Methods of Optimisation – Non-restricted

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Methods of Optimisation – Non-restricted

**Large number of variables
and constraints**

500 Heliostats

= 1 000 Variables

= 250 000+ Constraints

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Technical Model

8 h.   14 h.   20 h.

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Technical Model

Cosine

Blocking

Shading

Attenuation

Spillage

Objective Function

Find $\mathbf{X}$ and $\mathbf{Y}$ which maximises

$$f(\mathbf{X}, \mathbf{Y}) = A \sum_{k=1}^{192} \mathrm{DNI}_k \left(\sum_{i=1}^{n} \eta_{c_{i,k}} \eta_{a_i} \eta_{sp_i} \eta_{b_{i,k}} \eta_{s_{i,k}} \right)$$

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Procedure
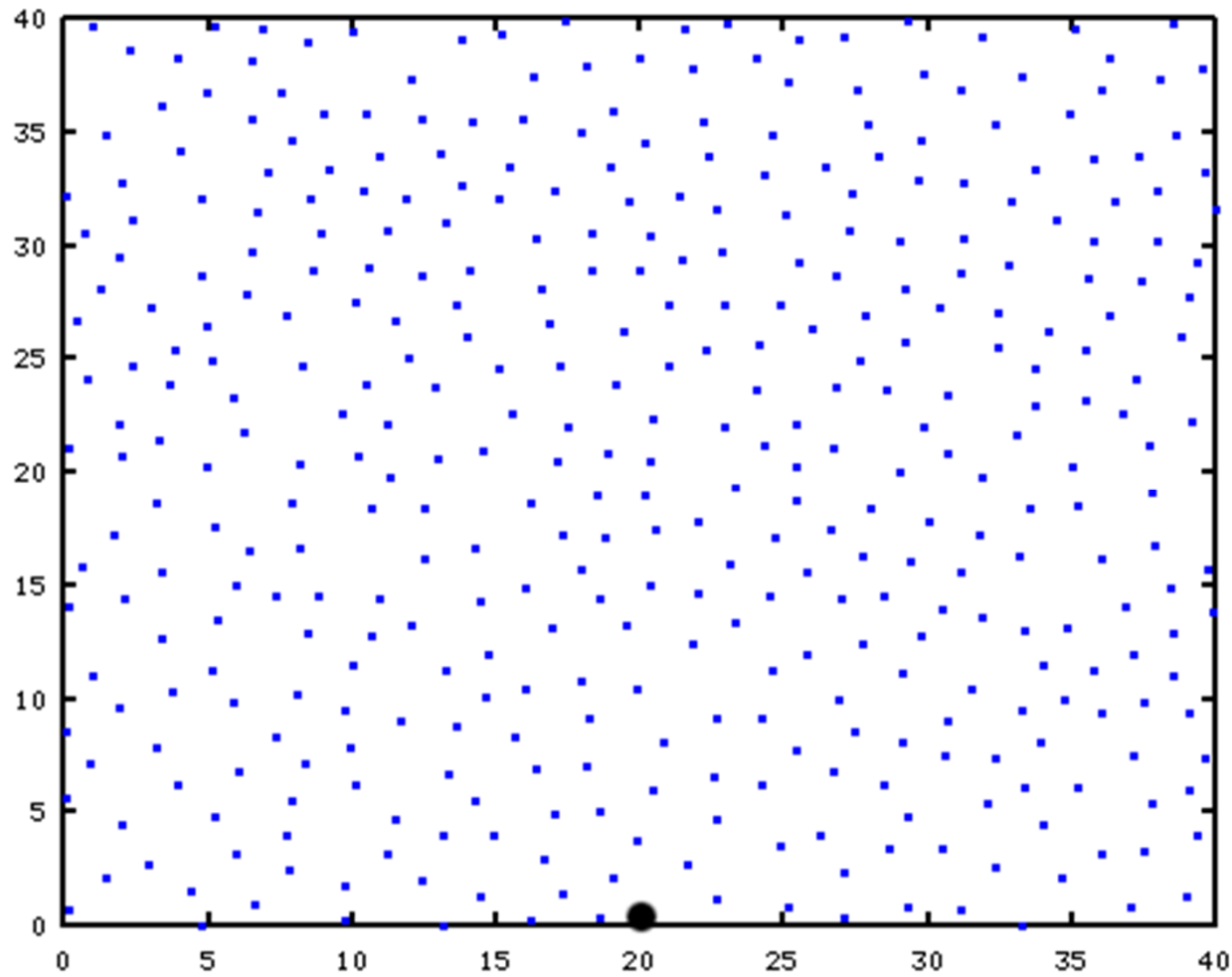
Technical Model

Optimisation Algorithm

Optimal Layout

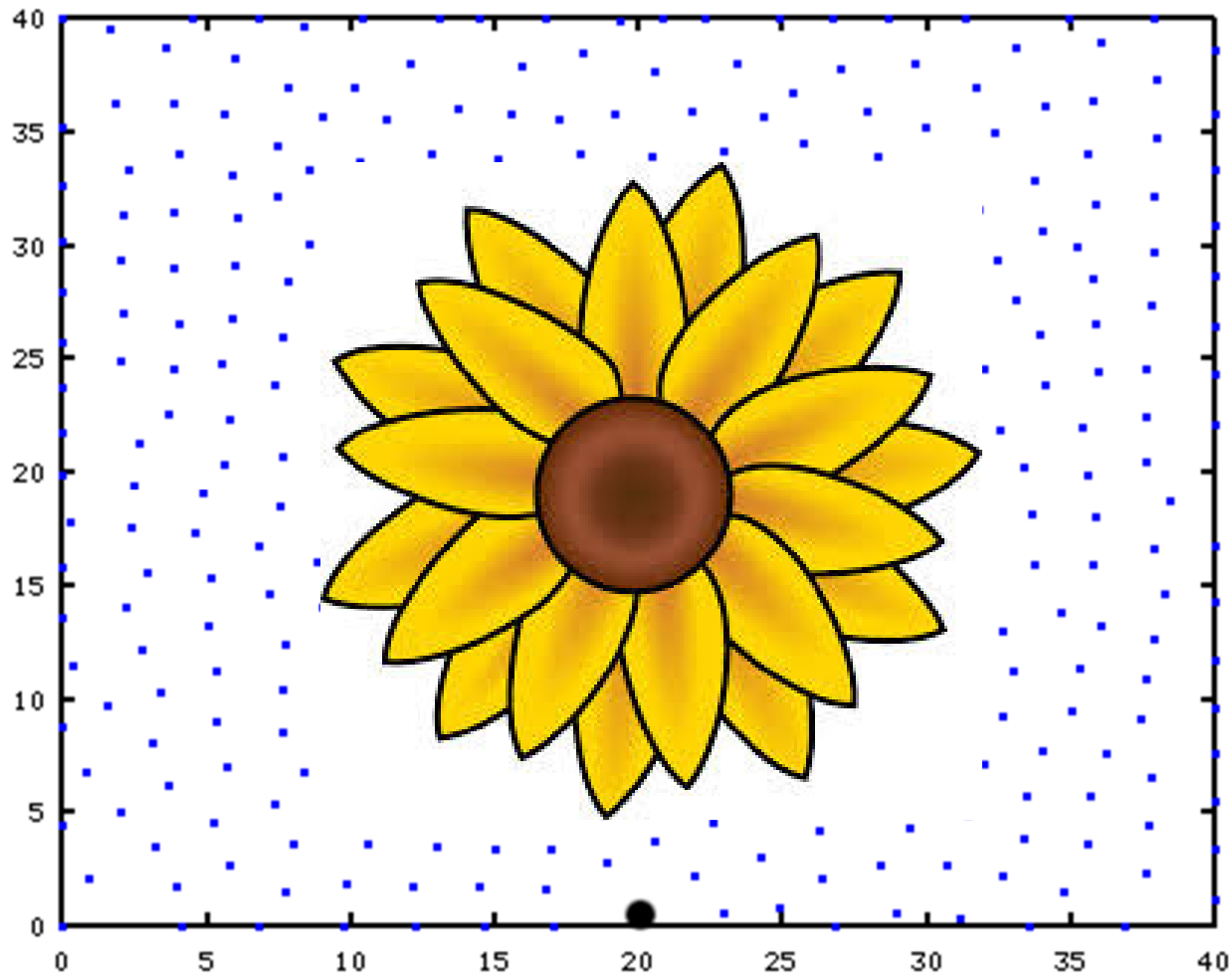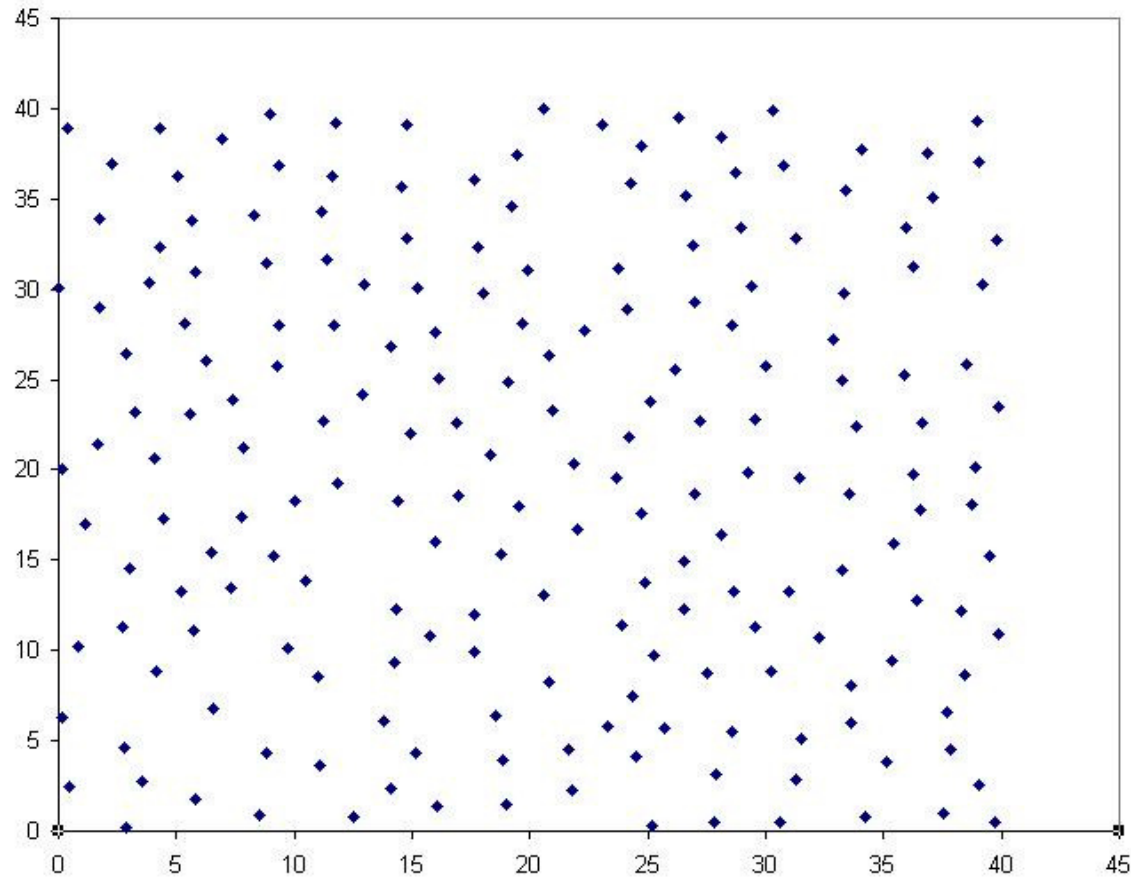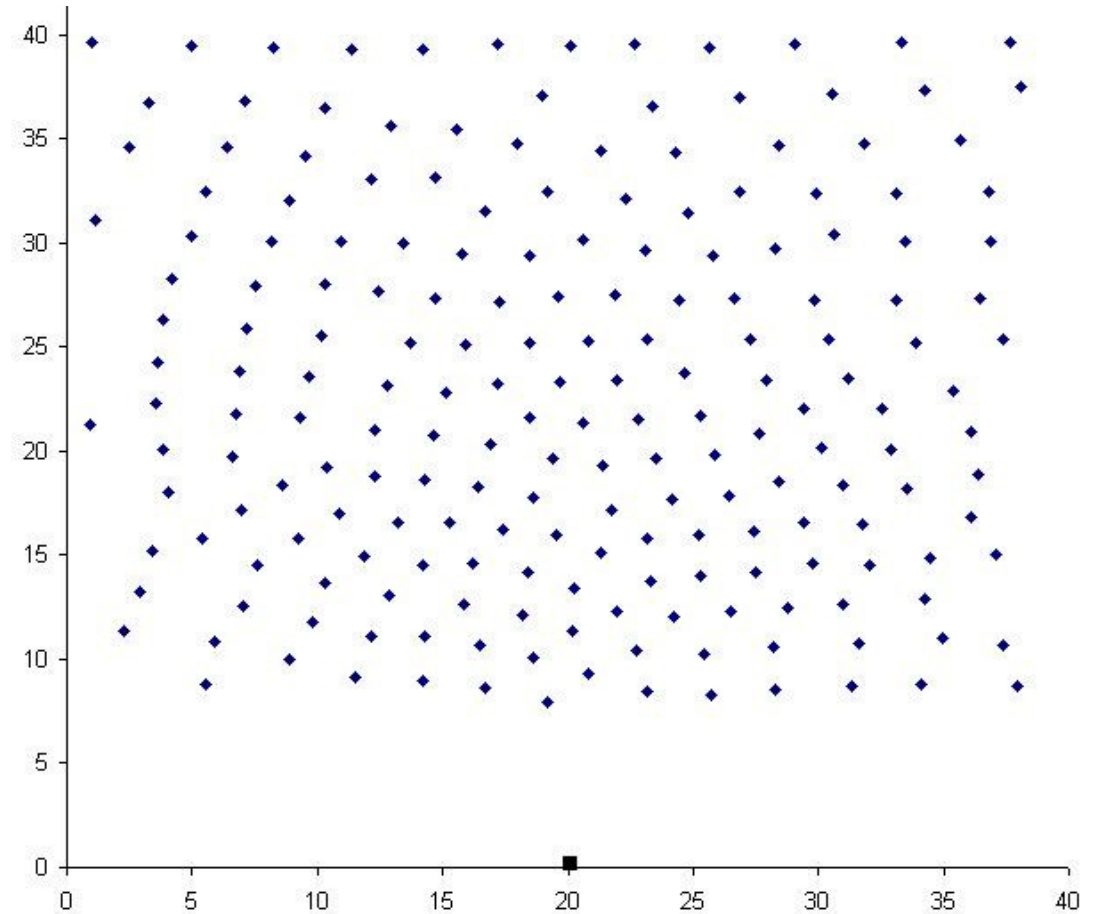Sequential Approximate Optimisation

Findings: Optimisation Runs

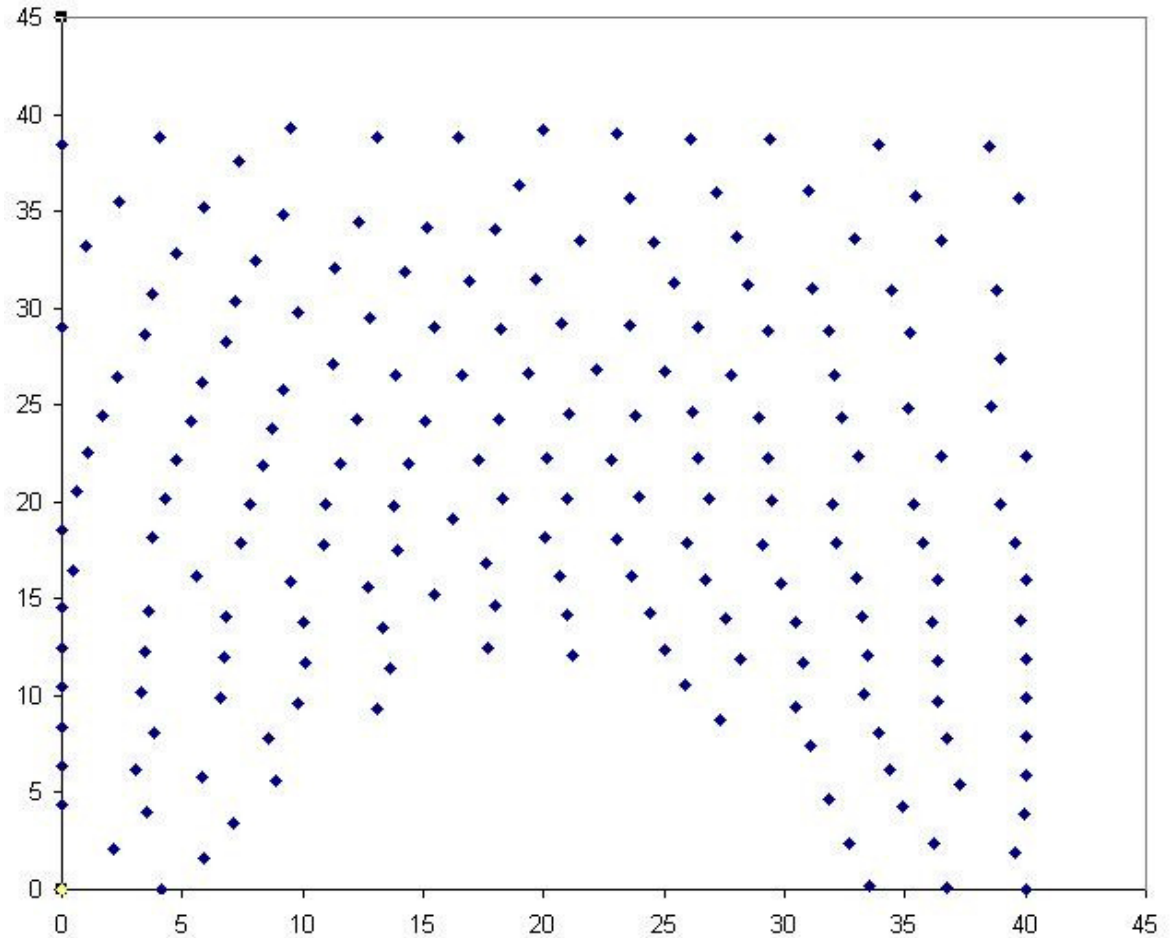# Findings: Optimisation Runs

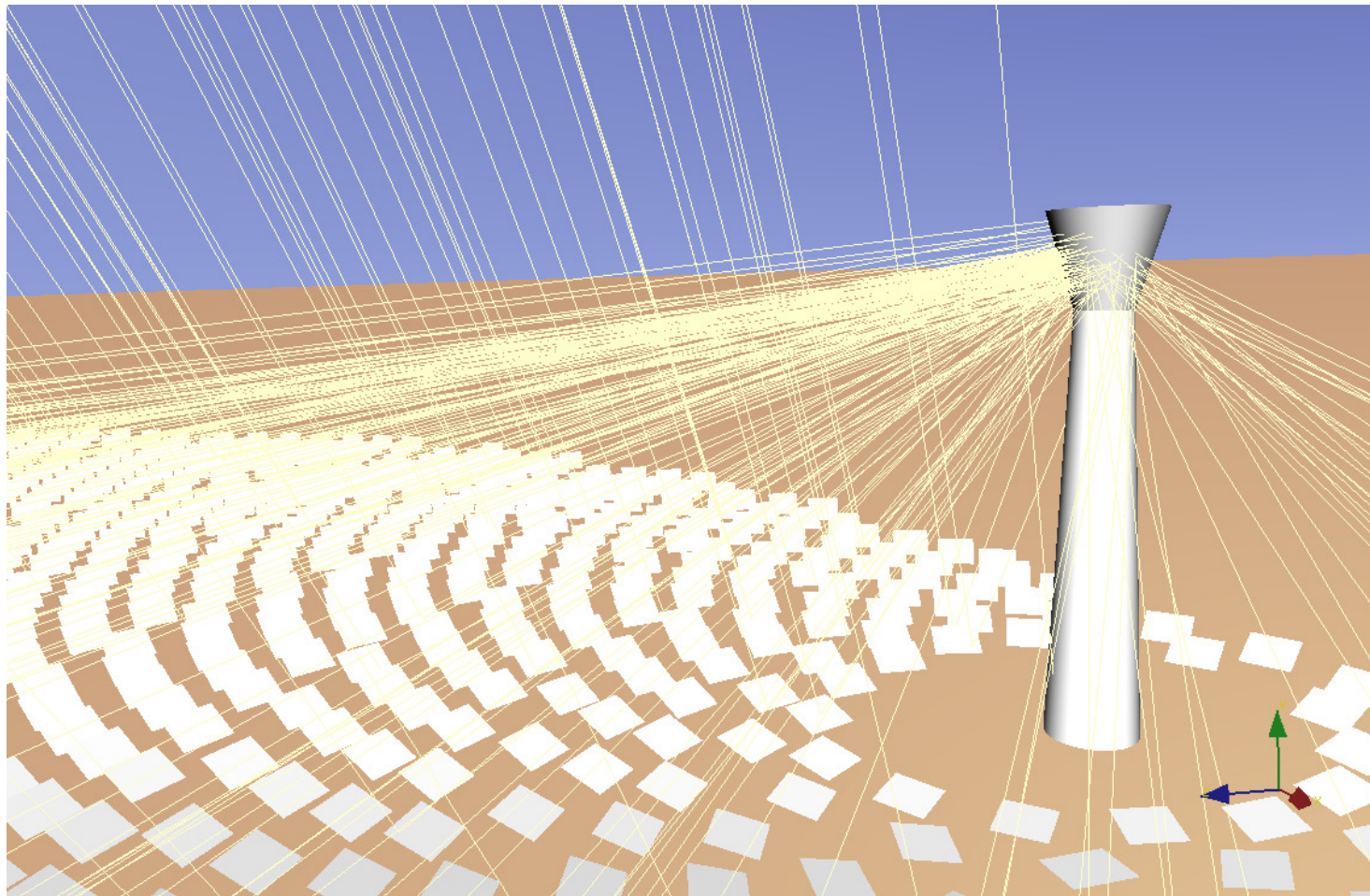# Findings: Optimisation Runs

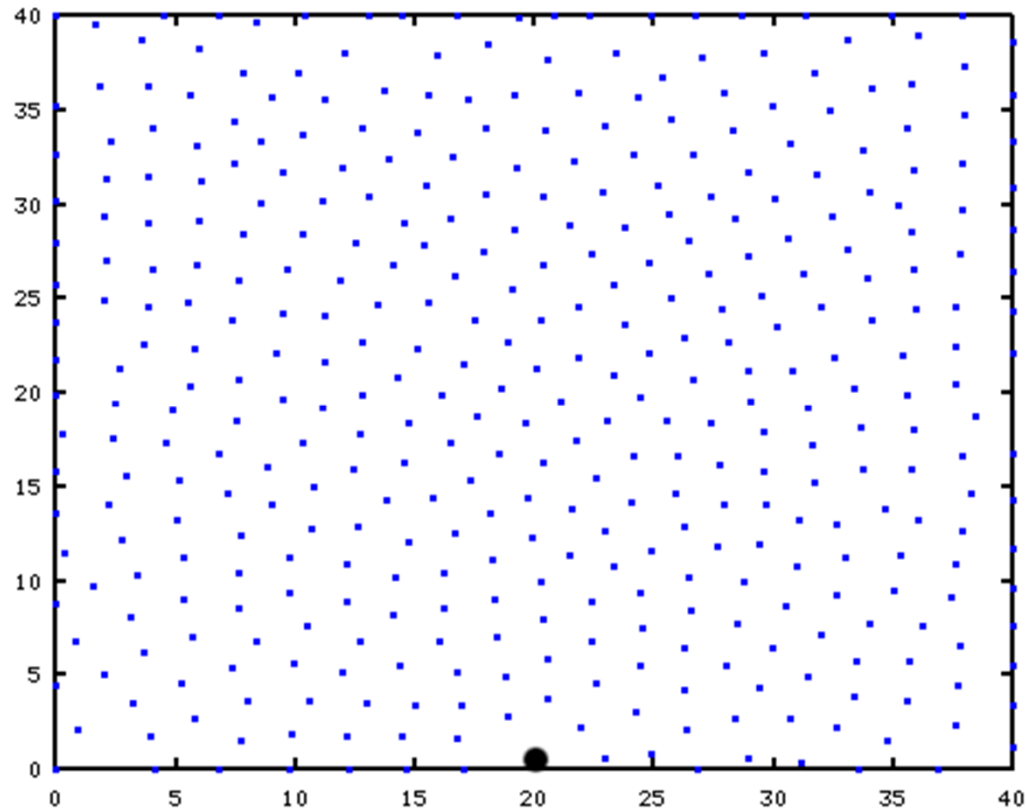# Findings: Optimisation Runs

Findings: Optimisation Runs

Findings: Ray Tracer Validation

Findings: Ray Tracer Comparison

My Model:
0.7% improvement

Ray Tracer:
2% improvement

Findings: PS10

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After 60 Iterations:
0.1% Improvement

Design Point:
55 MW x 0.1%
= 55kW

In 1 year:
Over 100 MWh

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Current Focus: Speed Up Optimisation