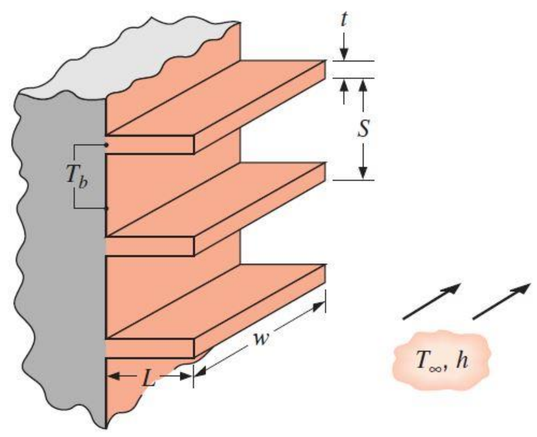
Optimization of Fin Geometries with a Genetic Algorithm

Objectives

- Create a **tool** to **automate** the **thermal analysis** of **arrays of straight fins**.
- Provide the possibility to reach **optimal designs** subjected to **financial constraints** and **performance requirements.**

Methodology

- A **genetic algorithm** (GA) finds the best possible **array of fins** by maximizing the **heat transfer rate**, given a set of **design constraints** and **goals.**
- 6 variables involved: number of fins, material, fin profile, width, thickness, & length.



$$q_t = hA_t\left[1 - \frac{NA_f}{A_t}(1-\eta_f)\right]\theta_b$$

Figure 1. Heat transfer rate from an array of fins [2].

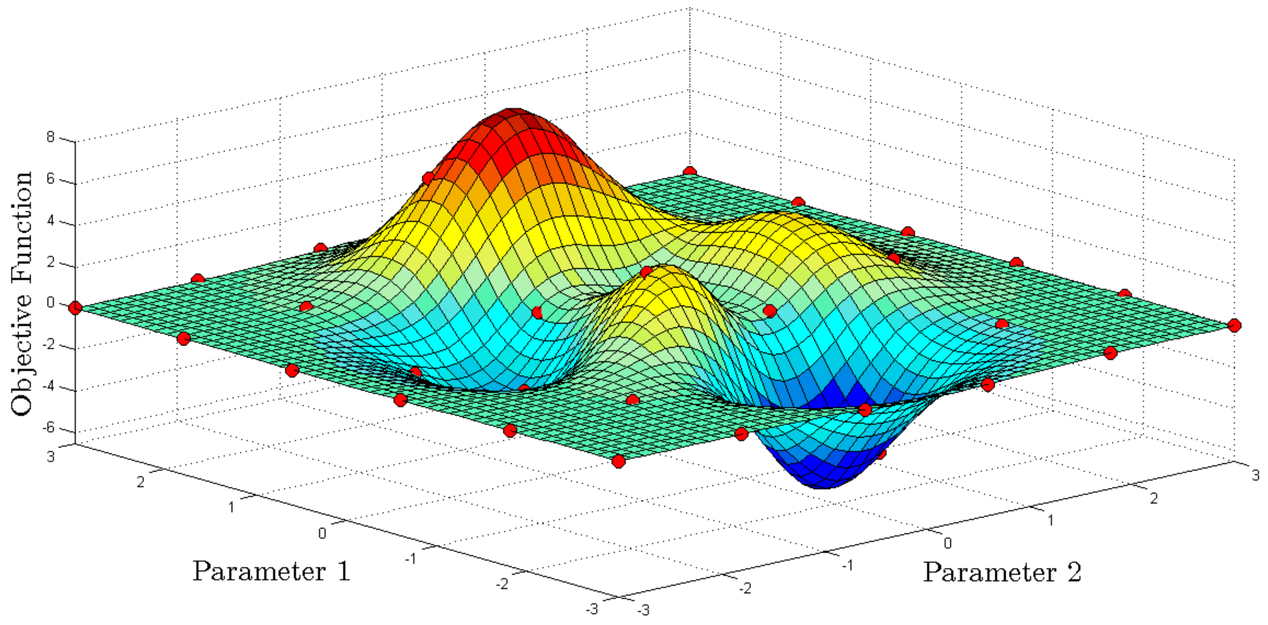


Figure 2. GA population exploring a surface with multiple local maxima [1].

Results

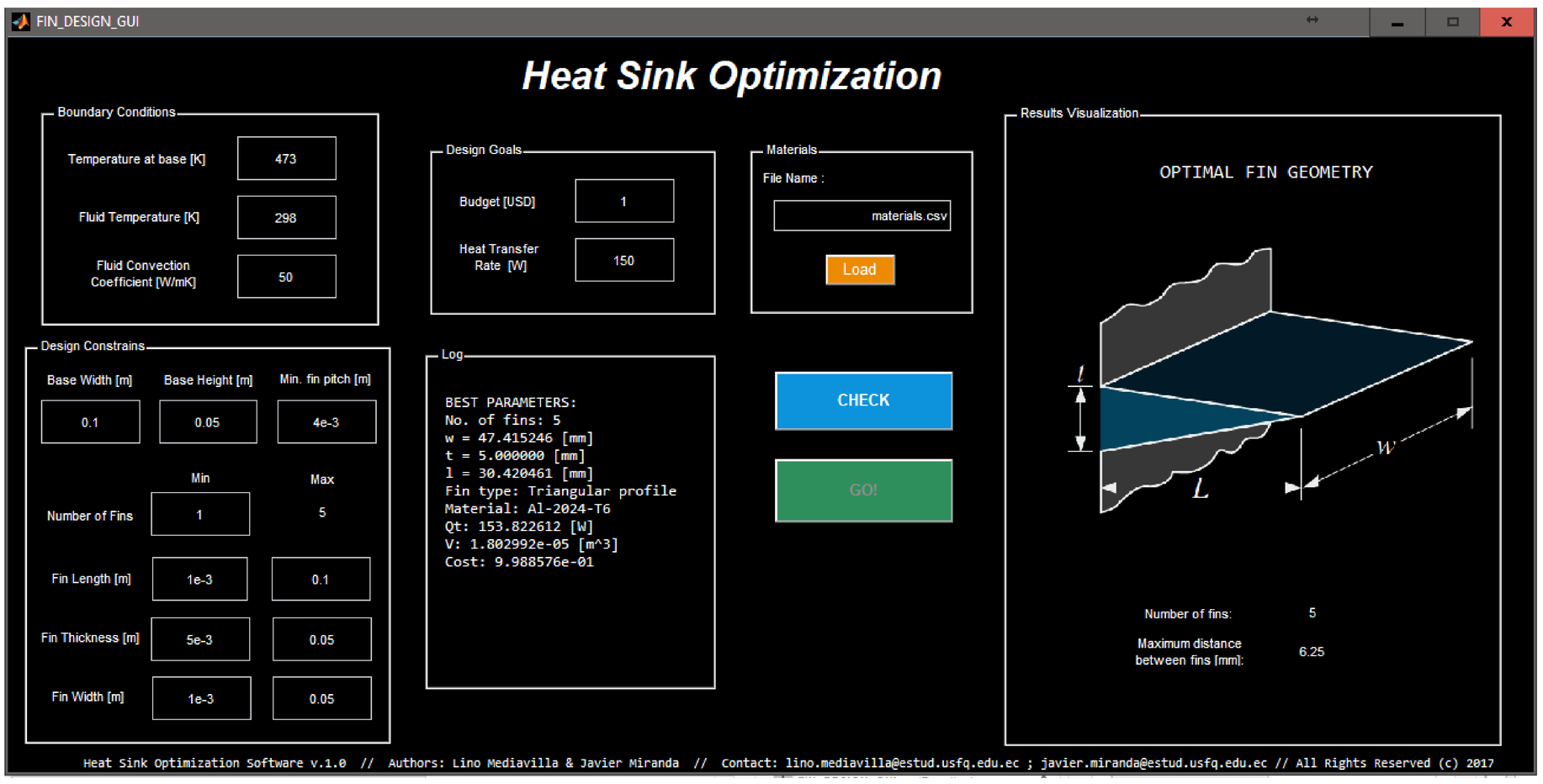


Figure 3. Fin design GUI implemented in Matlab.

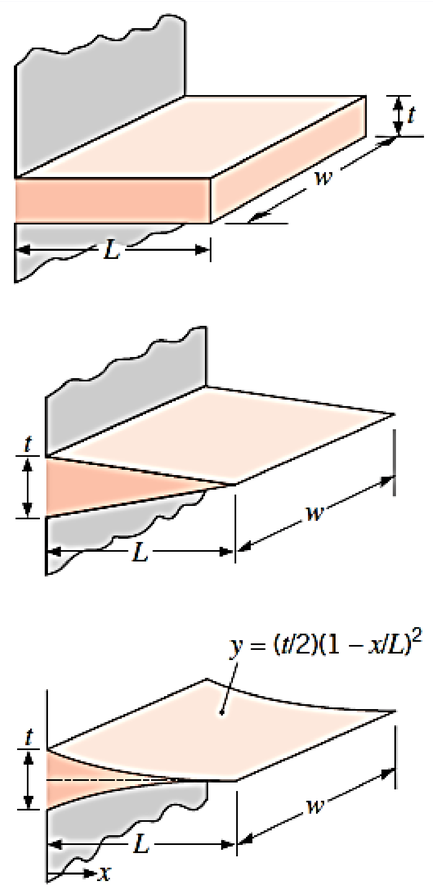


Figure 4. Fin profiles considered.

Conclusions & Remarks

- The software implemented allows to find **the best possible fin array** under **arbitrary design constraints.**
- Although the results from the thermal analysis may be encouraging, **mechanical properties** should also be assessed **to ensure that the potential designs are safe**.

[1] Haupt, R. L., & Haupt, S. E. (2004). Practical genetic algorithms. Hoboken, NJ: Wiley-Interscience.
[2] Bergman, T., Dewit, D., Lavine, A. and Incropera, F. (2011). Fundamentals of heat and mass transfer. New Jersey: John Wiley & Sons.

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