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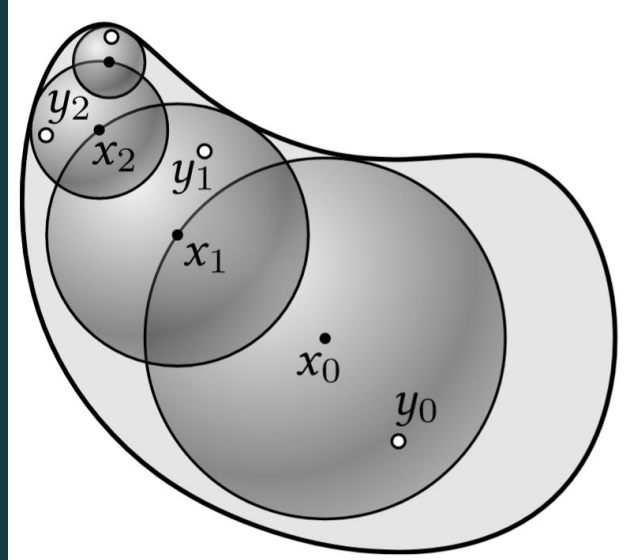
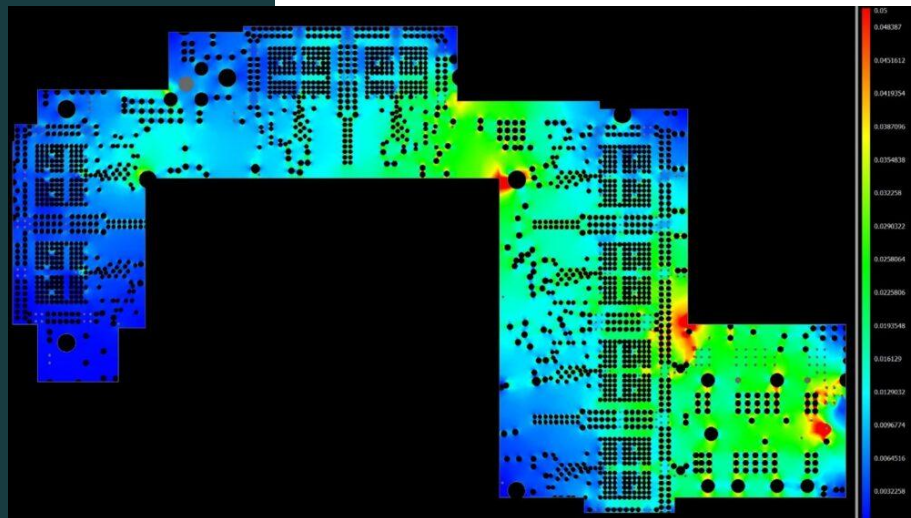
Walk on Stars for Interactive PCB Simulation

Milestone 2 Presentation



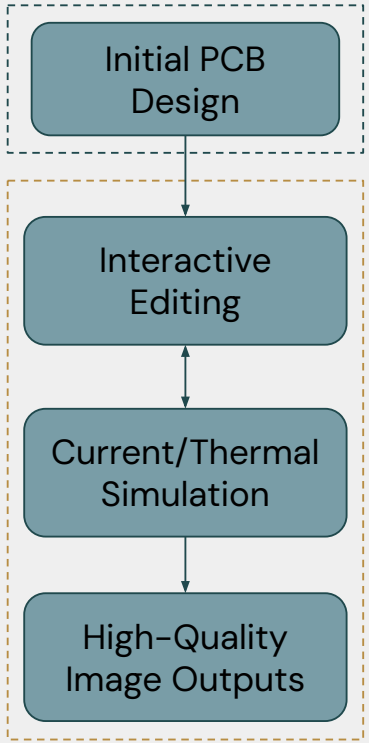


Project Recap

- **Problem:** Traditional FEA solvers for PCB designs are too slow for iterative prototyping
- **Our Tool:** WebGPU simulator using **Walk-on-Stars** algorithm for heat visualization with **interactive layout editing**
- **Goal:** Provide fast thermal insight during early design to catch hotspots and evaluate layout changes

KiCad Software

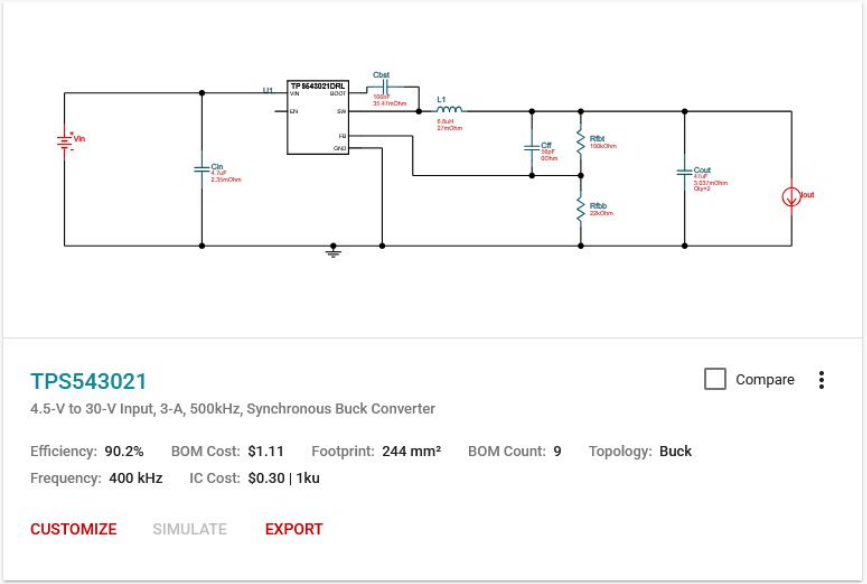
Our Website



https://resources.altium.com/p/why-you-should-use-thermal-prototyping-instead-simulations

KiCad User Advice

- Focus on component heating
- Make boundary/power distribution setting easy
- Use TI WEBENCH® for simple power designs
- Compare against other available solutions



https://webench.ti.com/power-designer/switching-regulator/select

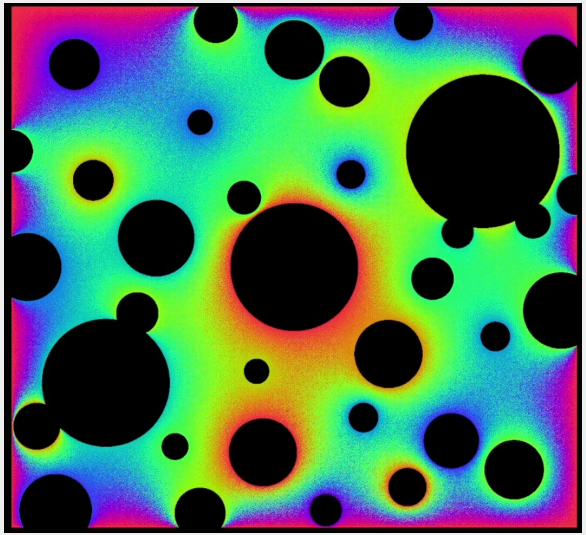
Current Progress

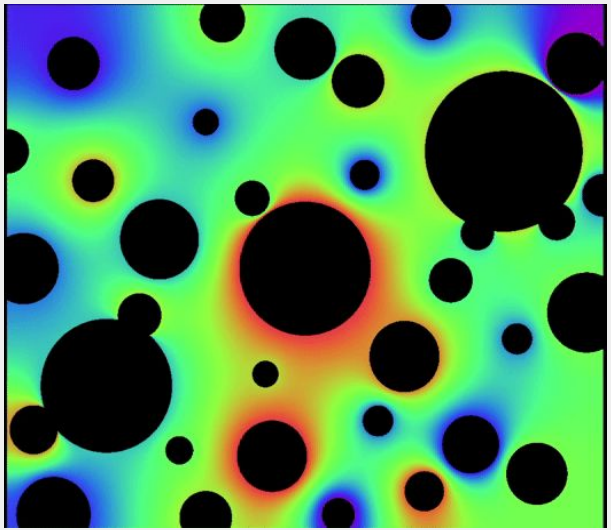
Walk On Spheres / Stars

Walk On Spheres

Walk On Stars

- Visually converging simulation
- Boundary geometry and values as input buffers
- Basic Walk On Stars implementation (Dirichlet + Neumann boundary conditions)

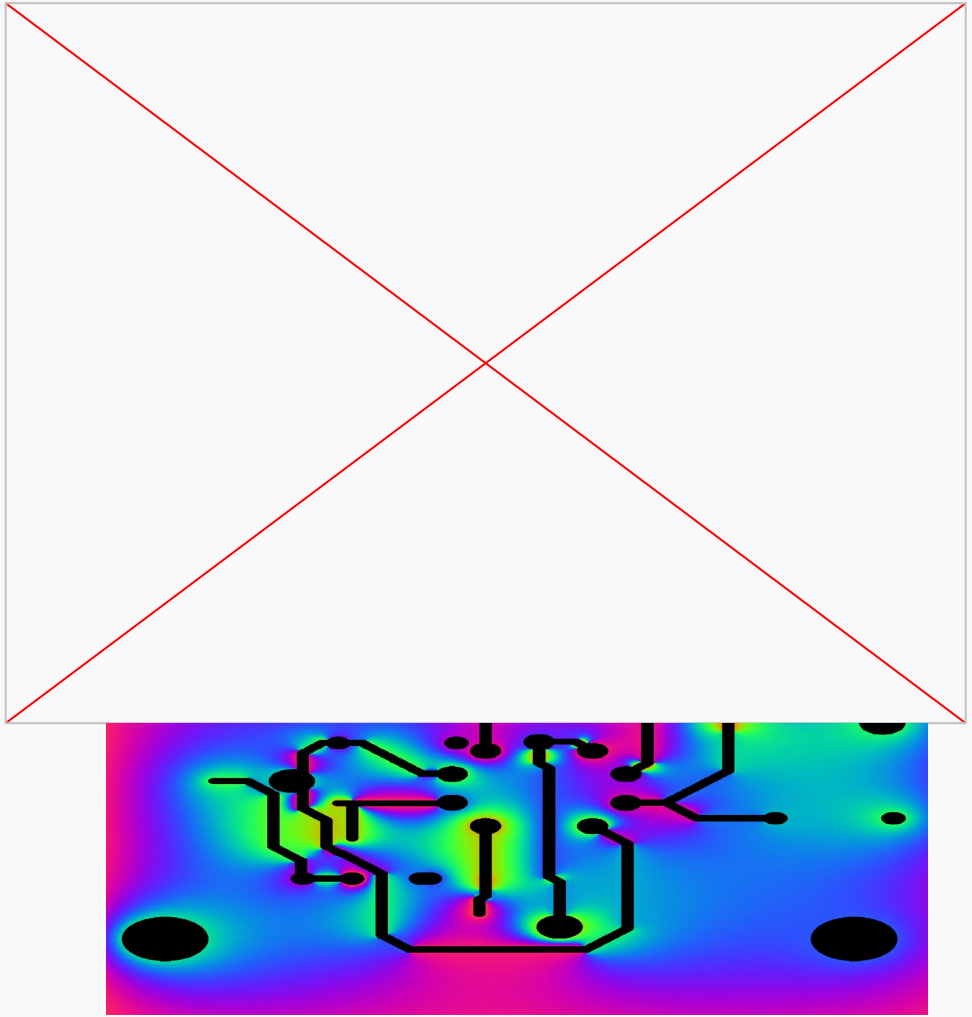




Current Progress

PCB Editing

- KiCad Importing
  - Circular pads & straight traces
- WoS overlay
- Camera Control
- Width modification

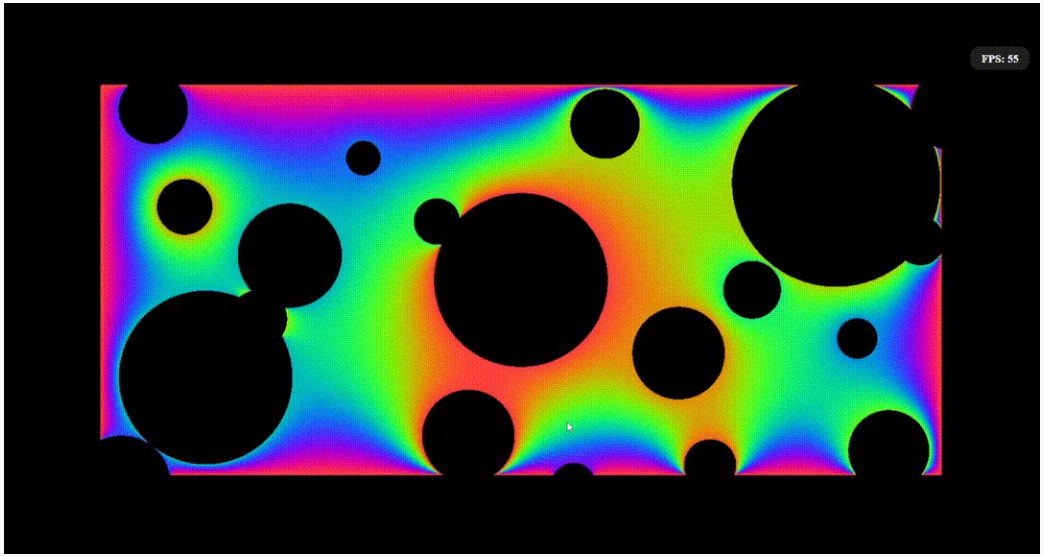


Kicad ecc83 demo board:
https://gitlab.com/kicad/code/kicad/-/tree/master/demos/ecc83

Current Progress

Zoom, Pan and Selection

- Allow the user to move the camera view
- Only simulate selected area, saving unnecessary computing
- Live FPS display



Next Steps

- More User Interaction
  - Add interface for users to change the boundaries, models, ...
  - Add probes to monitor the real-time value of a position
  - (optional) Add analysis dashboards or tailored suggestions with AI

Next Steps

- Combine Everything
  - User interaction + Solver = Output
- Solver Updates
  - Take into account board materials
  - Faster closest point queries / boundary testing
- Editor Updates
  - Exporting to KiCad (fork kicadts)
  - Component Heating
  - Layer specifications for constants