Interpreting the world on a different plane

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Optimization of PCB supports during In-Circuit testing of electronics

24/10/2016 Sudarshan Hegde/Vijeesh Vijayan

BOSCH

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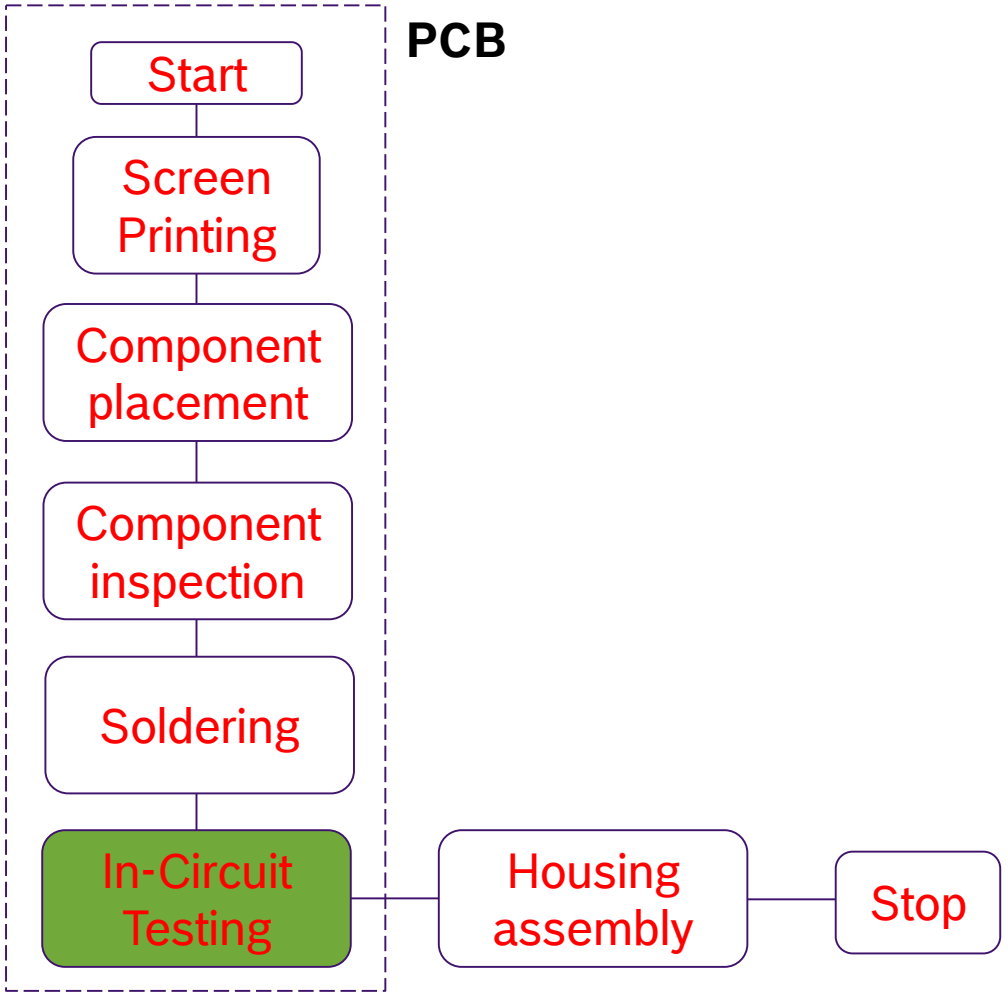
Electronic Control Units

Manufacturing



Todays automobile is driven by electronics

i.e. interacting sensors and actuators

Electronic Control Unit

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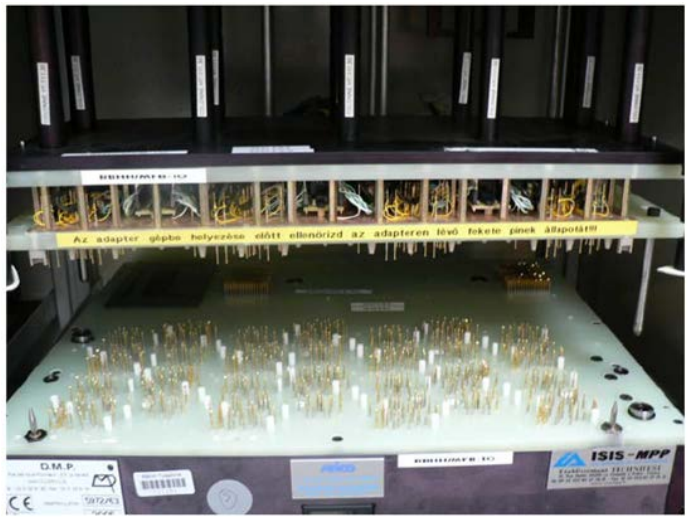
In-Circuit Testing

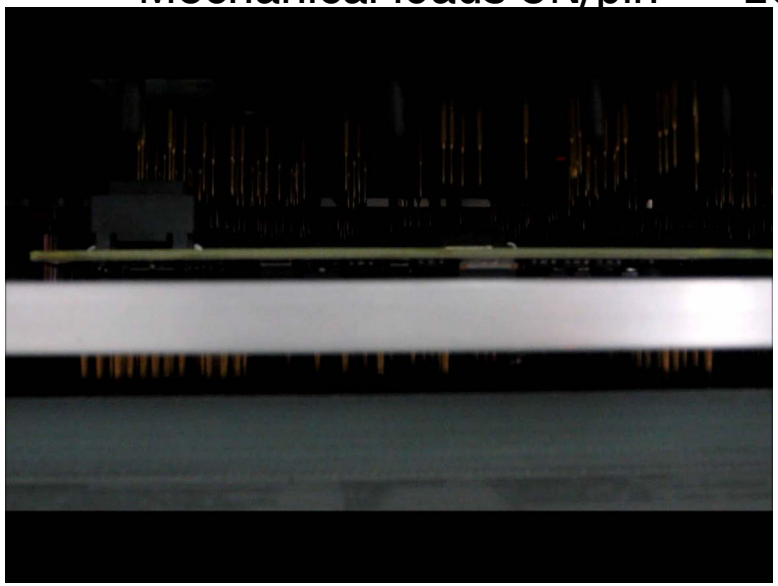
Electrical Verification Tests:

- To verify if the Copper traces are manufactured correctly
- To verify if components are placed correctly

Mechanical loads 3N/pin × ~100 pins = 30 kg!



Spring-loaded-Needles



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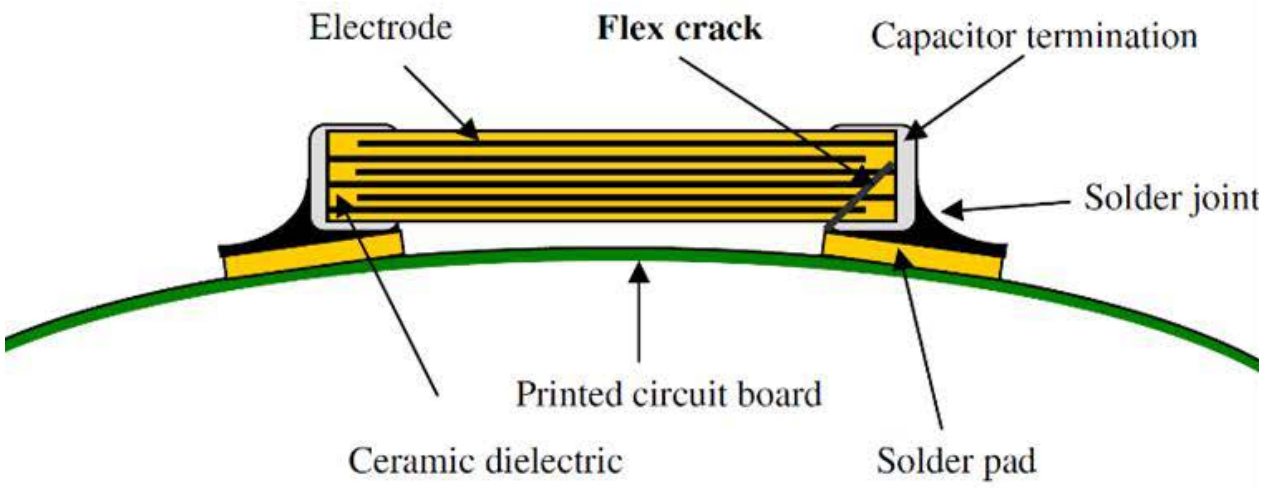

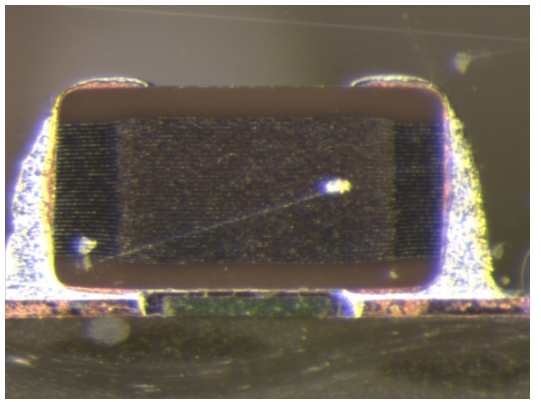

Cermaic capacitors

M. Keimasi, M.H. Azarian, M. Pecht, *"Isothermal Aging Effects on Flex Cracking of Multilayer Ceramic Capacitors with Standard and Flexible Terminations"*,

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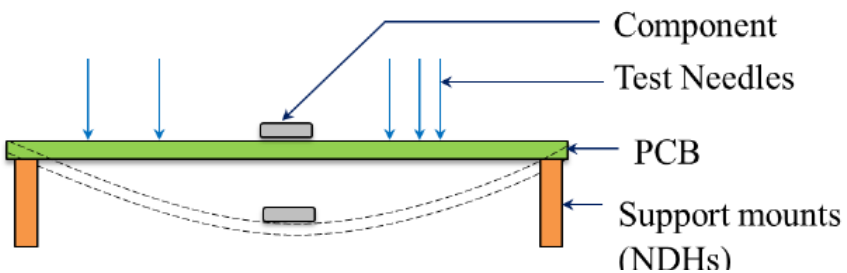

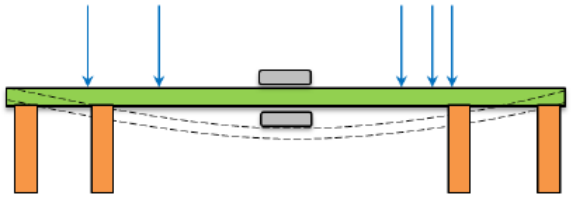

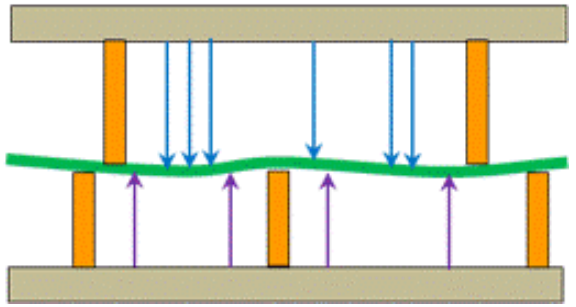

Introduce Support Mounts to reduce PCB bending and hence protect ceramic capacitors

Loads on both sides and hence need supports on both sides

Bending behaviour is complex! And needs a Finite element simulation

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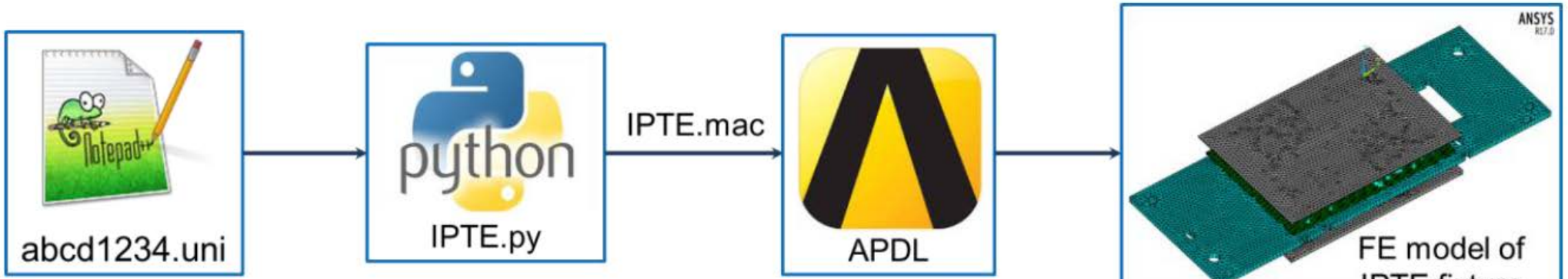
In-Circuit Testing

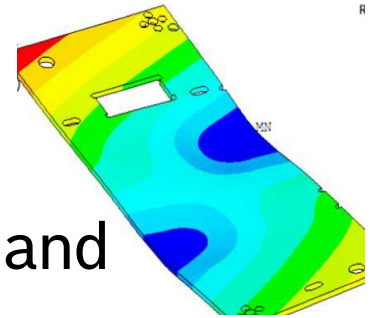


PCB
Layout file

Python
scripts

Ansys
Macro

Finite element
Model



Engineer uses judgement and experience to place the supports, and does trialsin simulations! **Can this be eliminated?**

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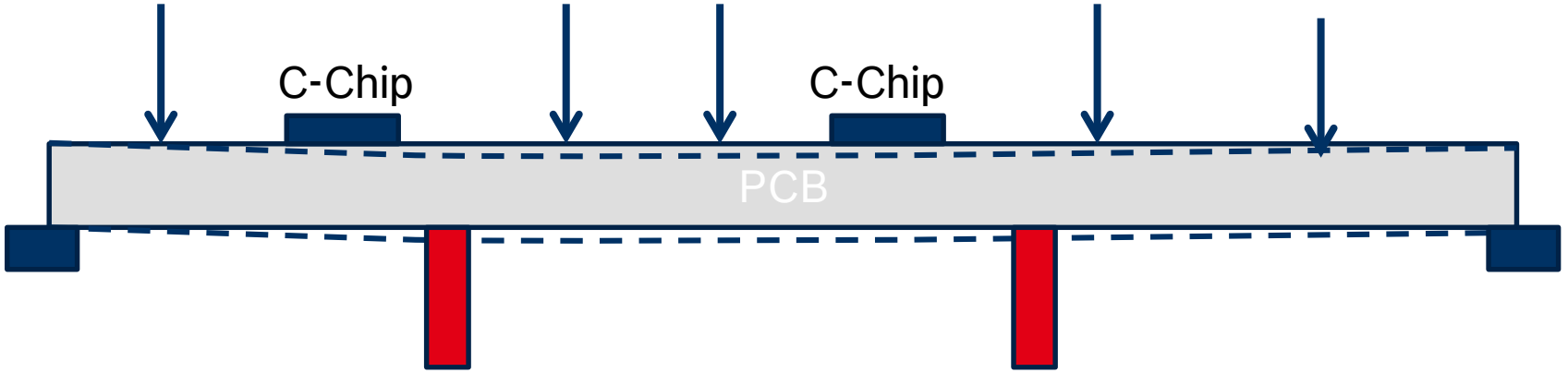
Problem



In-Circuit Testing

Solving the Problem: Where to place supports?

so that C-chips do not break

Complexity control in the topology optimization of continuum structures

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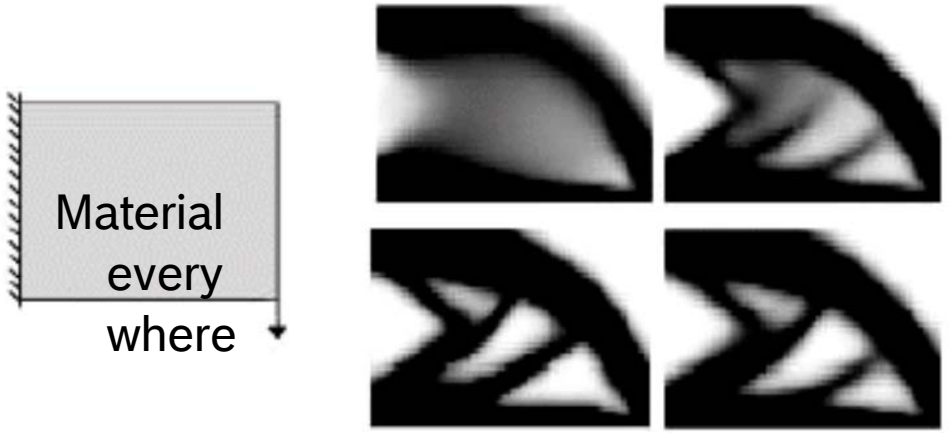
Topology optimization



Mindset:

Comes from Topology optimization; Start with material everywhere, and then start removing

Complexity control in the topology optimization of continuum structures

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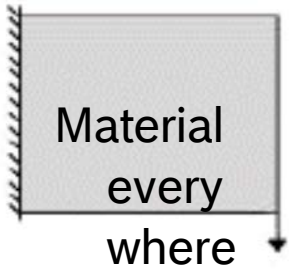
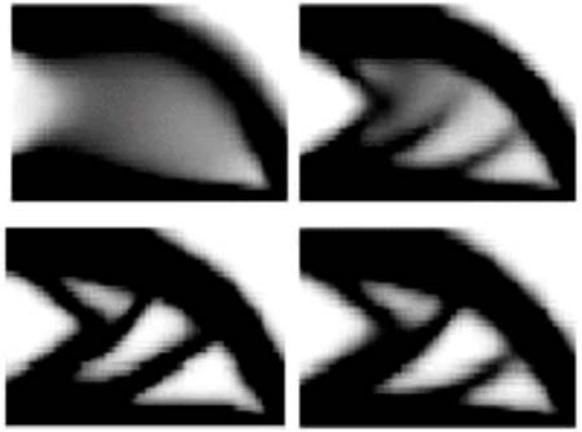
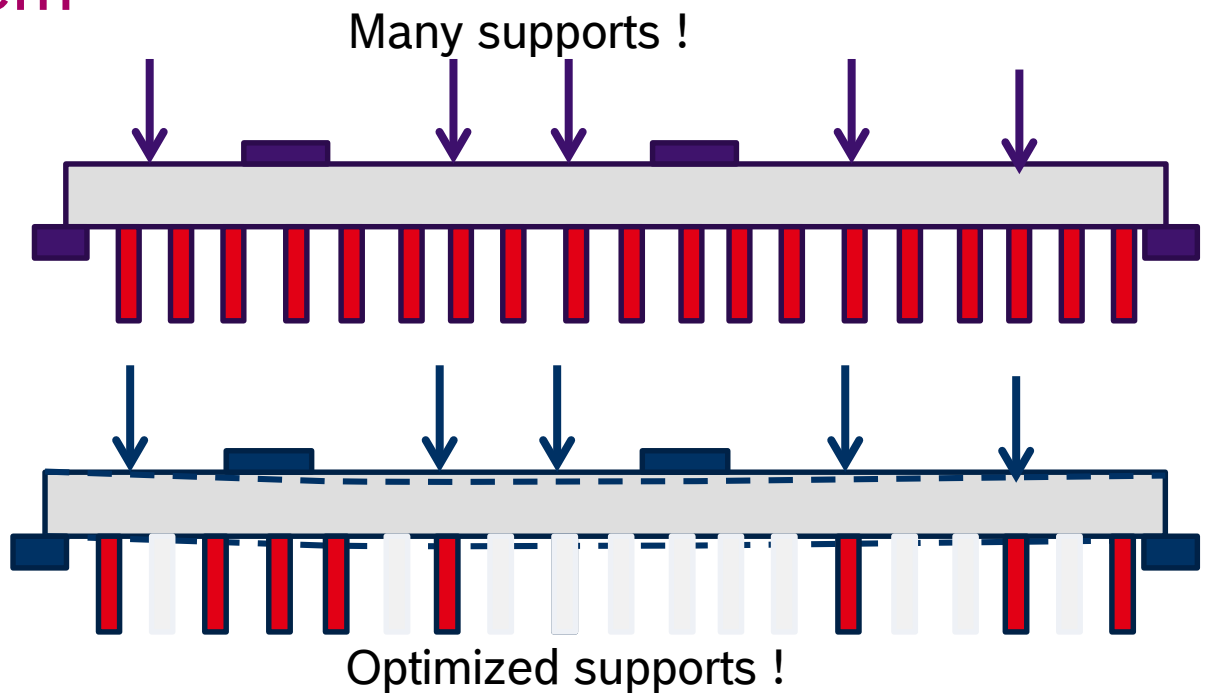
Framing an optimization problem







Mindset:

Comes from Topology optimization;
Start with material everywhere, and then start removing

Optimization Problem:

Minimize →No. of Supports
Subject to:
Constraint→ strains at C-chip< x um/m

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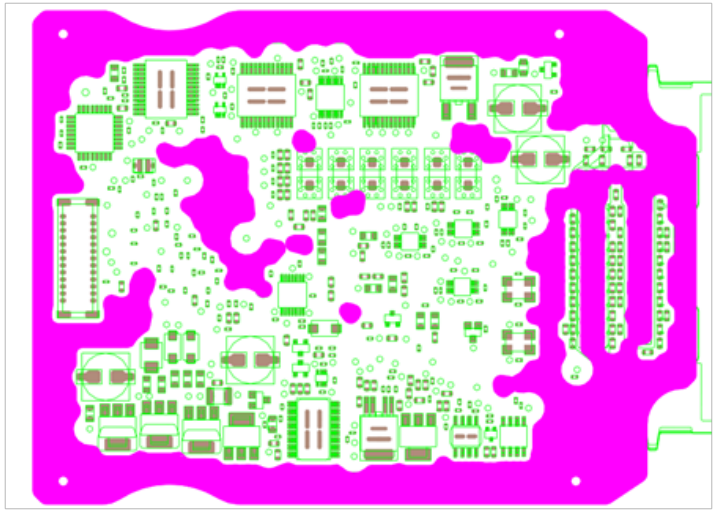
More constraints



Things are more complicated (Constraints!)

limited space

minimum distance between supports

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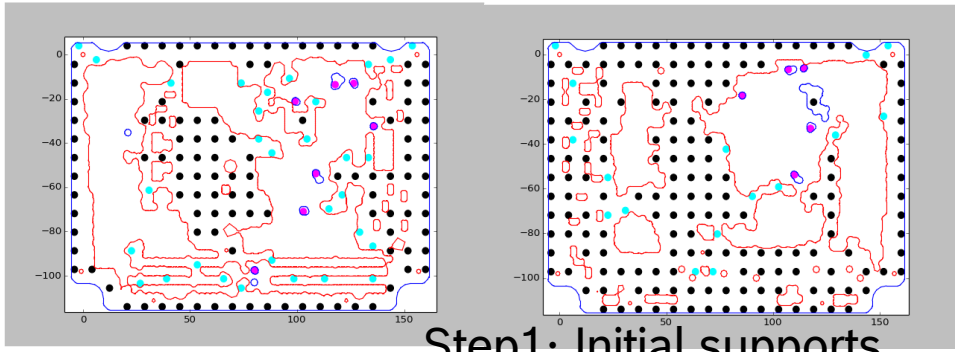
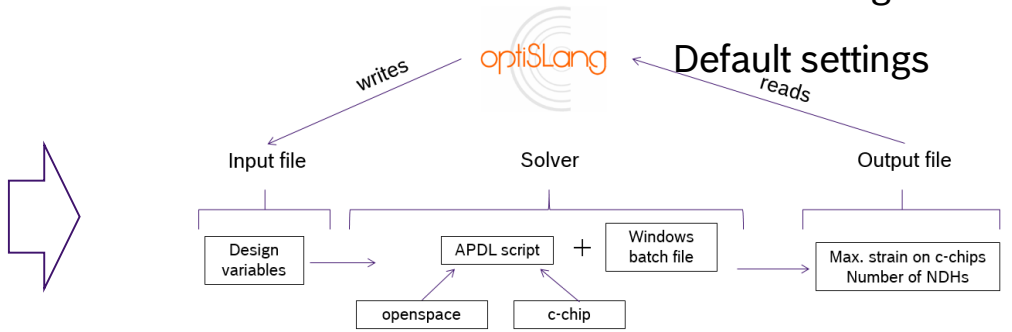
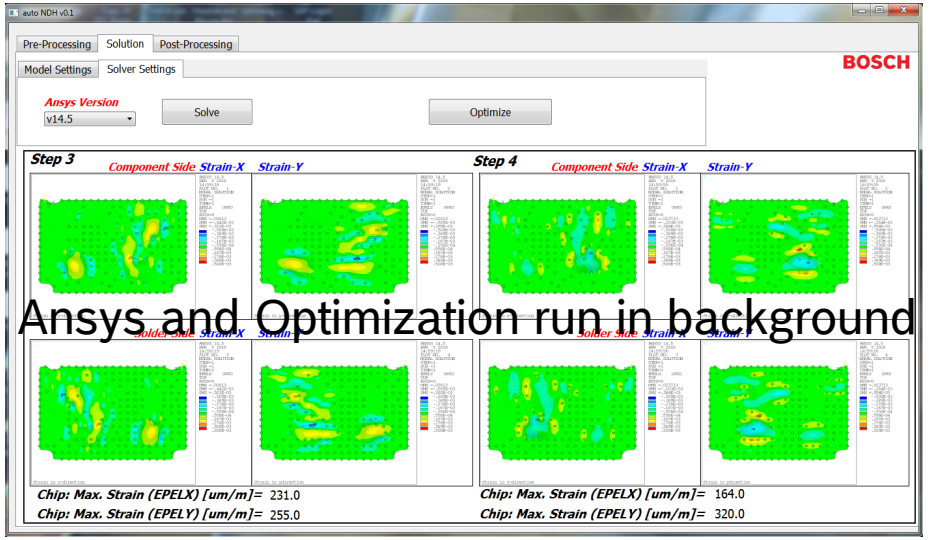
Automated GUI



Step1: Initial supports





Ansys and Optimization run in background

ANSYS®

optiSLang®

CADFEM®

Support by CADFEM-India is appreciated

Fully automated GUI with very limited user interventions possible

Thank you