Optimal Support Placement for Fixture Generation

Category: Graduation project

Education level: M.Sc. Electrical Engineering, Embedded Systems

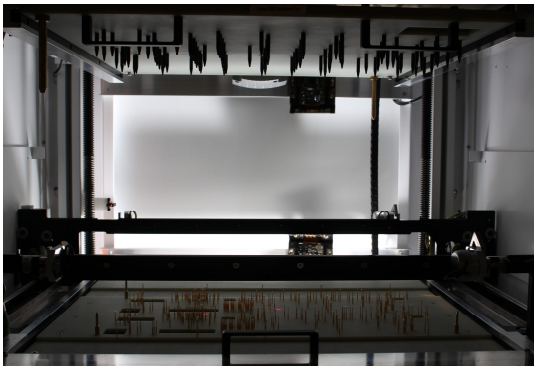
Company

Prodrive Technologies is a developer and manufacturer of world-class electronics. It comprises over 1250 employees and is one of the fastest growing companies in Europe. The organization is mostly based on two groups: Development and Operations. The Development department is oriented at developing first-class electronic, mechanic and software solutions. The operations department is responsible for production, assembly, testing and life-cycle management of electronic products and systems in the range of 1 to more than a million pieces per year.

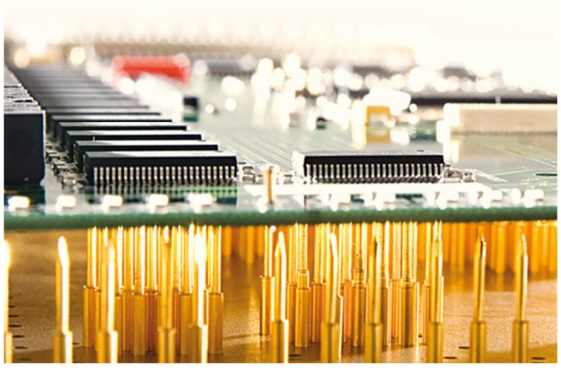
Background

At Prodrive, automatic electronic tests (AET) are used to test assembled printed circuit boards (PCB(A)). This is performed in the following manner:

- The PCBA is loaded into the testing machine and horizontally locked using alignment holes.
- The PCBA is vertically locked using a top fixture containing push fingers.
- A bottom fixture containing the test probes and support probes is pushed against the PCBA.
- The PCBA is tested using the test probes making contact at the test pads on the PCB.
- The bottom fixture, top fixture and PCBA are released in the inverse order used for locking all.



The bottom fixture and top fixture.



PCBA on a bed of probes.

Ideally, all push fingers on top of the PCBA would be aligned in the direction of applied force with all testing probes at the bottom. This is unfortunately rarely possible because of components placed at the desired finger locations.

Take for example a chip, mounted on the PCB using a ball grid array (BGA). Under this chip, several test probes might be needed to verify a correct working of the chip. However, push fingers cannot be placed on top of the chip because of manufacturer requirements and need to be placed around the chip, or even at a distance because of other components placed in the direct neighbourhood. Hence, push fingers need to be placed several centimetres horizontally

from the test probes. An individual test probe might exert less than a Newton of force, but a group of test probes can together produce multiple Newtons, deforming the board.

In such a deformation, build-up strain can exceed a certain threshold where components might come loose, resulting in lower reliability of the tested product. In the example, strain will accumulate at the corners of the chip. With large chips and/or a lot of test probes underneath, solder connections can fracture.

Goal

The Goal is to create a test fixture design based on a given PCB design. This will eliminate engineering work required to manual design the fixture. Which will result in faster lead times and lower fixture cost. At Prodrive, software is under development to automatically calculate maximum strain levels using the PCBA design, test probe types and locations, and push finger locations.

Problem Description

The next step to reach the goal is the development an algorithm which, using only PCBA design and test pad locations as input, automatically calculates locations for an optimal number of push fingers such that the maximum strain stays within specified boundaries, or reports to the user that such a positioning of push fingers is impossible to realize with the PCBA design. The three main boundaries are a minimum distance between push fingers and components on the PCB, a maximum board strain, and a maximum board strain acceleration.

Deliverables

The project consists of the development of an algorithm that can solve this discrete non-linear problem. In case the problem cannot be solved exactly but solving requires e.g. converging iterations, boundaries must be derived specifying how accurate the computed solution is.

- The algorithm described in the previous section.
- Software implementations as a proof of concept.
- A comparison between theoretical results and a practical test using strain sensors. The practical results could be retrieved during the graduation preparation phase.

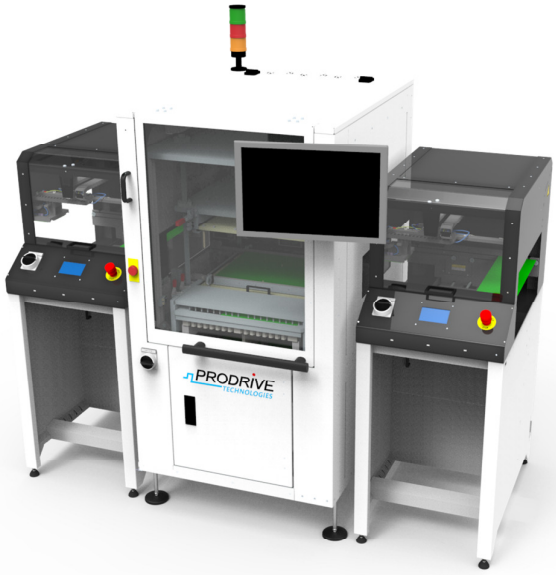
Working environment

The project will be done within the AET team at Prodrive, a team consisting of both software- and hardware engineers. Support on specific topics, e.g. finite element analysis (FEA), is available at different departments and (PhD) researchers at Prodrive. Martien Spierings will be the main supervisor.

Contact information

Phone: +31 63 17 76 273

E-mail: martien.spierings@prodrive-technologies.com



Prodrive's test platform