Improving CellPod Production Time and Quality with Rapid Prototyping

A solution to repeatably find correct length of sensing pins

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Abstract

Battery testing currently faces two big challenges. Firstly, batteries are tested in batch in large thermal chambers[1]. This makes testing inflexible and time-consuming as single batteries can't be tested under different conditions at the same time. Secondly, the main mode of heat transfer in thermal chambers is convection whereas heat transfer by conduction is dominant in battery packs[2], which makes data unrepresentative.

Cognition Energy's CellPod is a novel battery tester that aims to solve both problems, by testing batteries in individual pods where heat is transferred by conduction. The CellPod recently started shipping to customers, however many assembly steps could still be optimized to produce the CellPod faster and to a higher quality. To do this custom jigs, fixtures, and tooling must be developed.

During my summer internship I have developed 19 such jigs. A key bottleneck in CellPod assembly, which took a lot of time, was mounting the retractable pin that measures voltage. This poster will follow the development of a jig that speeds up this assembly step and improves part quality using an iterative design process.

Motivation

- The CellPod aims to revolutionize battery testing by being more flexible, and more closely simulate real world situations.
- To bring the CellPod to market, custom jigs, fixtures, and tooling must be developed.

Fig 1: A picture of the first batch of CellPods.

Method

- Identify bottlenecks in assembly together with Operations Lead.
- Design a jig that solves this problem and prototype it using resin 3D printing.
- Implement this prototype jig into the assembly line and get feedback on how it can be improved.
- Act on feedback iteratively.

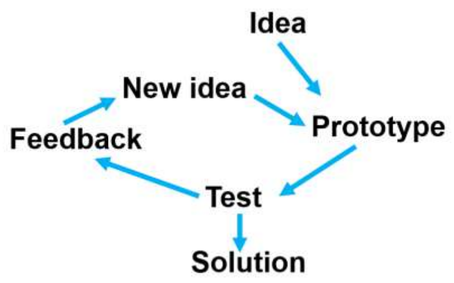

Fig 2: A diagram showing the workflow of iterative design.

The problem with length of pins

Currently the contact pin is connected to its contact housing by gauging the length of the pin by hand, attaching pin by supergluing, and waiting around 2 min until the superglue has set. In total this adds up to 3 minutes per part, which could be better spent on other assembly steps.

Ideally one should have a jig where one could drop in the pin and apply the superglue. Then let the superglue set while other assembly steps are carried out. This jig should be easy to use and give repeatable results over time.

Thus 4 prototypes were made using resin 3D printing:

1) Drop pin into hole. However, the tension in the wire pulled the contact housing off axis, making this design unfeasible.
2) Slide the housing into a cut-out and drop in a pin. It was found this may contaminate the contact pin, which is undesirable.
3) Use set screws to keep housing still. However, the tips of the set screws would wear down easily.
4) Keep contact housing still by fastening it to the part it will attach to later, putting it into the jig, and then drop in the pin to correct length.

The 4th prototype was found to satisfy the design criteria for the jig.

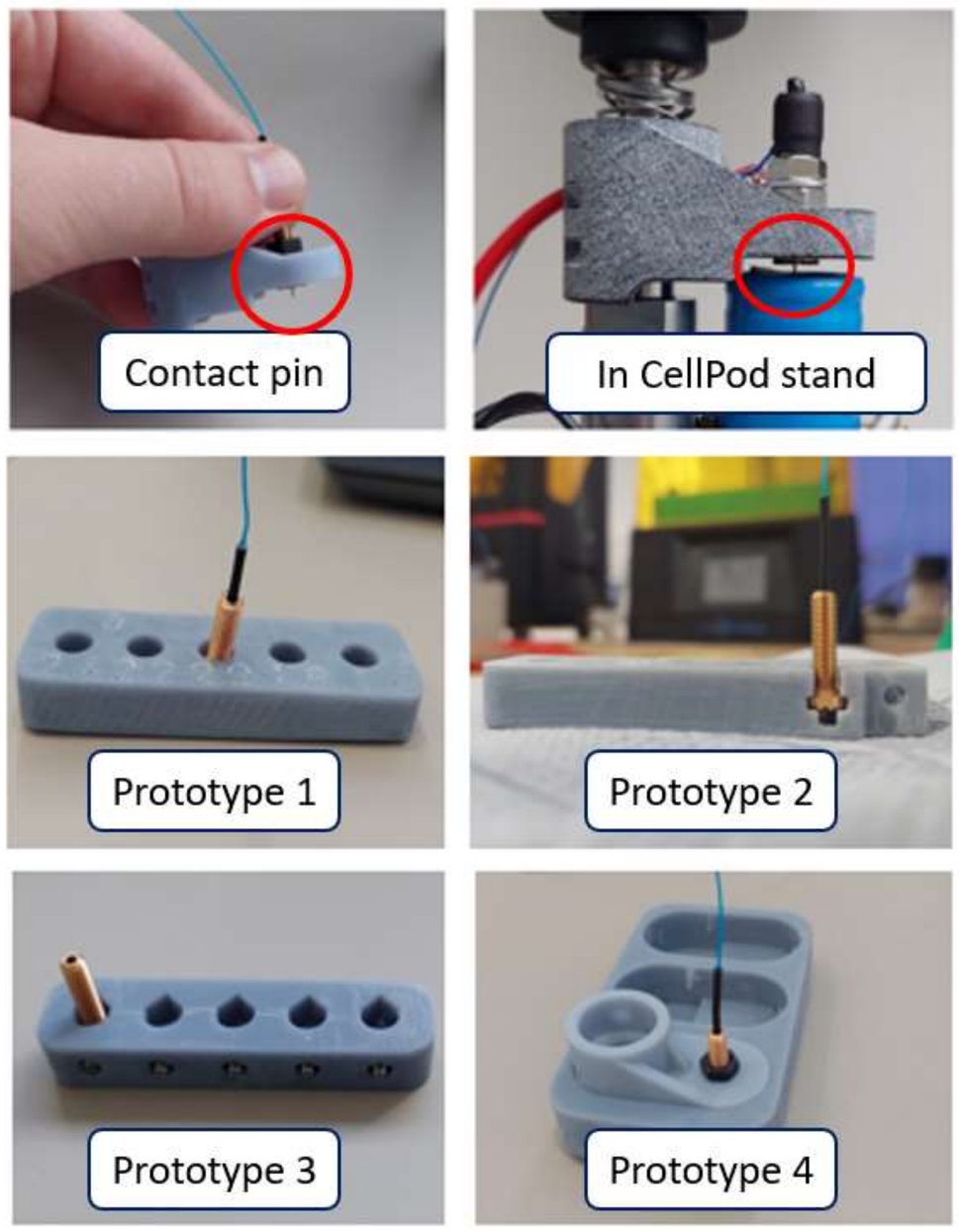

Fig 3: Top row: the contact pin and how it fits into the CellPod assembly. Bottom two rows: Prototypes and final design of sensing pin jig.

Conclusions

The final jig had several advantages over the initial assembly procedure.

- Time saved as one doesn't have to wait for superglue to dry
- One assembly step is eliminated as contact housing is secured to the part it will be connected to in the final assembly.

Additionally, the final design is possible to manufacture using CNC. This brings the manufacturing time of the jig down from 12 hours, when produced with resin printing, to 15 min. This allows the jig to easily be produced when needed.

Fig 4: The final version of the pin alignment jig manufactured by CNC machining from wood laminate.

Impact / Next steps

- Assembly time reduced by **80 %** from around 3 min to 30 seconds per sensing pin. This saves **10 min per produced CellPod**
- In total, around **2 h 45 min** assembly time **saved per CellPod** for all jigs made, a total time saving of **30 %.**
- Next steps include repeating this iterative process for more assembly steps, to further streamline CellPod assembly Design jigs and make documentation in a way that more jigs can be produced as the assembly line grows.

References

[1] M. Dubarry, G. Baure, *Electron. 2020, Vol. 9, Page 152* **2020**, *9*, 152.

[2] D. Kang, P. Y. Lee, K. Yoo, J. Kim, *J. Energy Storage* **2020**, *27*, 101017.

Intern bio

I am studying Materials Science & Engineering at Imperial College London. My interests include batteries, additive manufacturing, and machine learning.
I aim to use my skills in engineering, materials science, and prototyping to pursue a career in R&D to help bring new sustainable technologies to market in order to achieve a greener future.

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