

Custom Candidate Sets in Optimal DoE-Builds

ADJUSTING A DOE TO UNPREDICTABLE CIRCUMSTANCES

Introduction

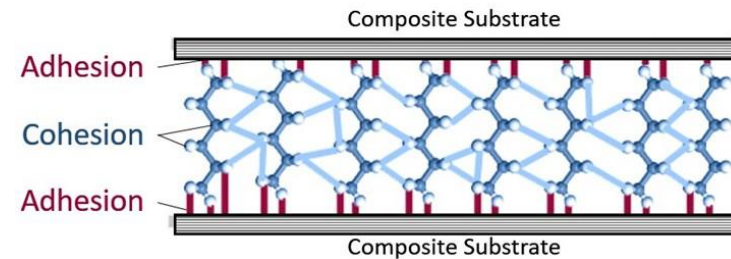


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- Background: MSc. Statistics (TU Dortmund)
 - Minor in Mechanical Engineering
- Occupation: Manager and statistics Consultant

- Company: Statcon GmbH
 - Statistical Training, Consulting and Software Sales since 1989
 - German Reseller for Statease (since 1994)
 - Focus on DoE and Industrial Statistics

Background

- Statcon is supporting an R&D project of a big German engineering company
- The goal is to identify and quantify influences on adhesive bonds
- An adhesive bond can theoretically be influenced by a lot of things
 - Substrate
 - The adhesive
 - Preparation methods
 - Gluing process
 - ...



Workflow of the Project

- First Statcon moderated a brainstorming session to collect possible influencing factors
 - Stakeholders of the project and suppliers of the raw materials participated
 - Participants from 6 different organizations with different backgrounds
 - Find and rank possible influencing variables
- More than 100 possible influencing variables were found
- From those 100 candidates, 12 factors were derived to be included in the DoE

The initial DoE

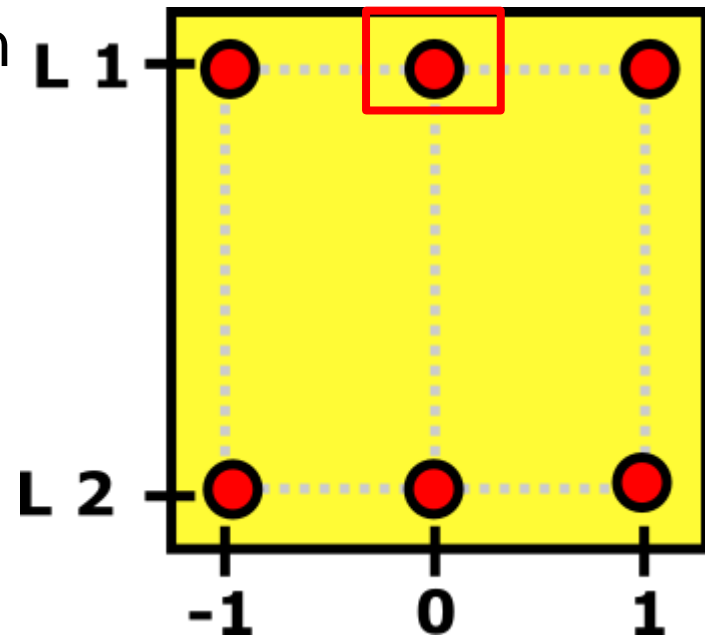
- Main Goal: identify important effects and interactions → Screening
- 12 Factors
 - 6 numeric discrete 3 levels
 - 6 categoric 2-Level
- Budget: 100 Runs
- Design: D-Optimal 2FI Model (90 Runs)
 - 10 Additional runs to check for quadratic effects

Set up of the original Design

DEMONSTRATION

The unforeseen Problem

- Two factors define variations in a product provided by a supplier
 - One numeric and one categorical factor define 6 variations of the product.
 - The standard product being the factor combination (0, Level 1)



The unforeseen Problem

- A supplier was not able to deliver the required amount of modified raw material
 - Minimum half of the runs had to be performed with the standard product, the more the better
 - The initial DoE used the standard combination in just 6/100 Runs
- Interactions with these factors were suspected
- We had to alter the DoE according to the available materials
 - Minimizing the loss of information was the primary goal
- Manufacturing of probes had already begun → Some factor combinations were unfeasible
 - Fortunately, the affected factors were free to choose

Idea for the altered DoE

- Use the current DoE as a candidate set, so that no new combinations of the unaffected factors are used
- 1st Step: build a viable DoE for the remaining 10 Factors while leaving the two others constant
 - Quadratic Model (10 Factors); D-Optimal
- 2nd Step: Augment the first Design to gain as much information as possible about the two affected factors
 - Quadratic Model (12 Factors); D-Optimal

Adjusting the Design to the unforeseen circumstances

DEMONSTRATION

Summary and Conclusion

- After setting up a 12 factor DoE for a customer a supply shortage forced us to keep 2 factors constant for most of the experiments
- With the use of custom candidate sets in Design Expert we were able to adjust the Design and minimize the loss of information
- Apart from obvious losses in the power of the two affected factors, the DoE remains able to estimate a quadratic Model and remains highly powered for the remaining factors
- The last experiments are performed at the moment, analysis will start shortly

Summary and Conclusion

- This talk is not a presentation of a new and effective technique to get DoEs with excellent quality.
- The resulting DoE is more problematic than the initial design
- The goal was to show the flexibility Design Expert and the DoE methodology present and how it's possible to modify designs if unforeseen problems arise in later project stages