Very Efficient Yield Estimation of the Microwave Performance of Very High-Accuracy Machined Parts

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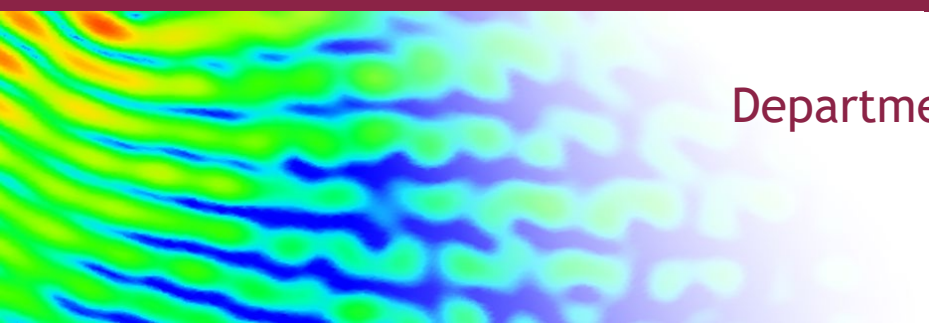

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Overview

- What is the problem?
- How can we improve that?
- Example
- Future

What is the problem?

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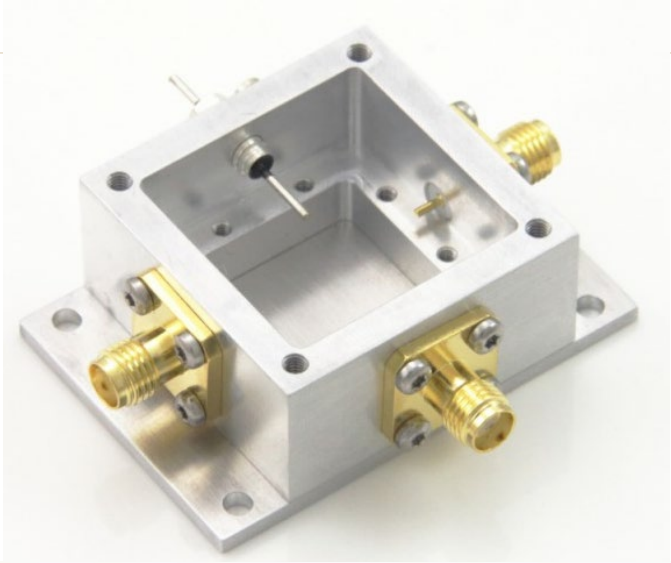
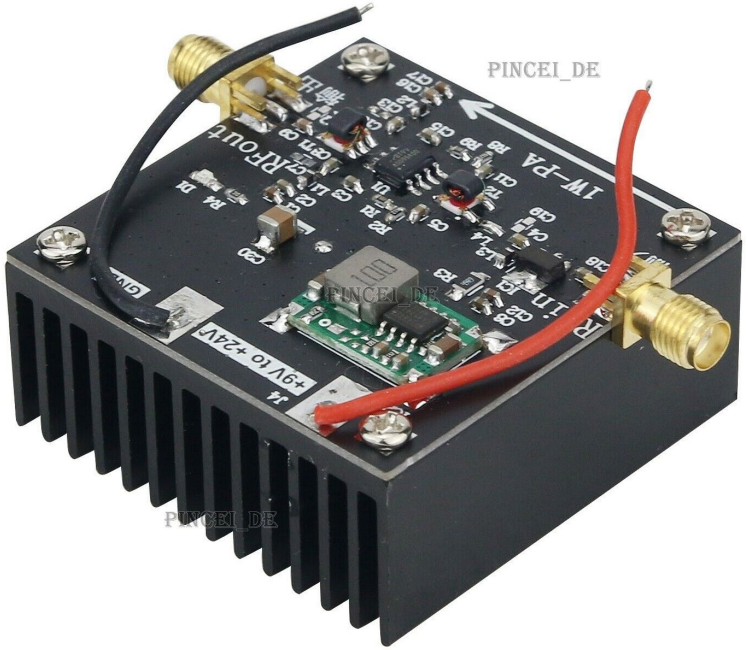
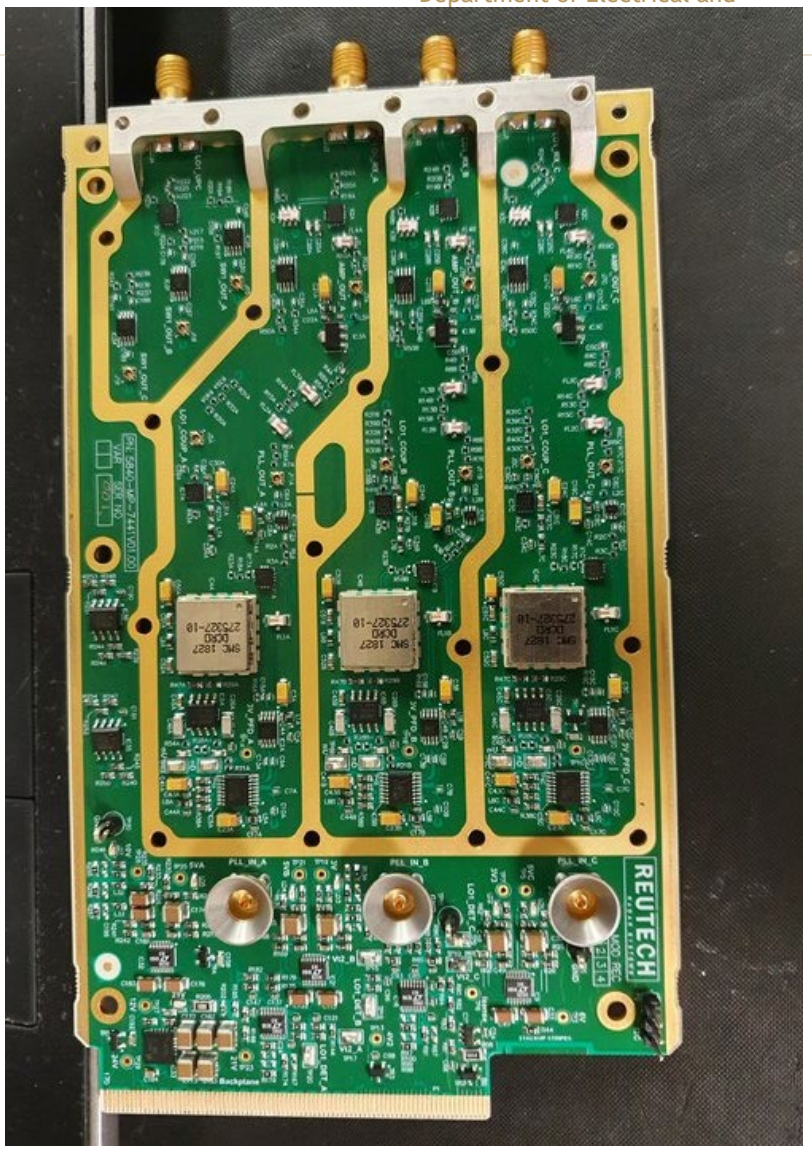
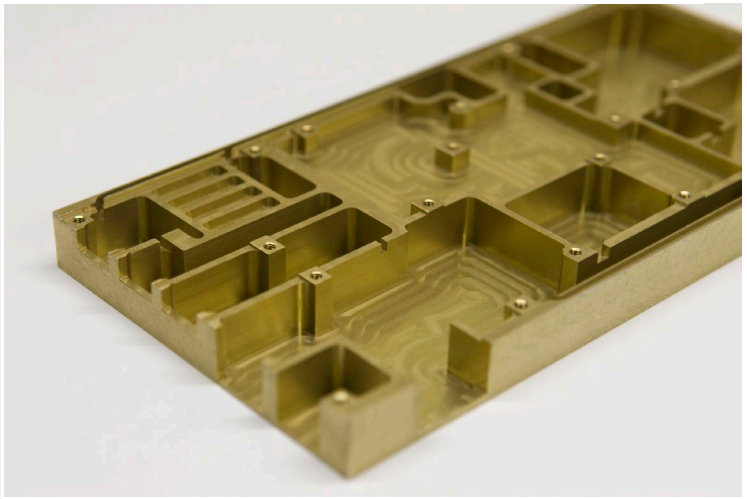
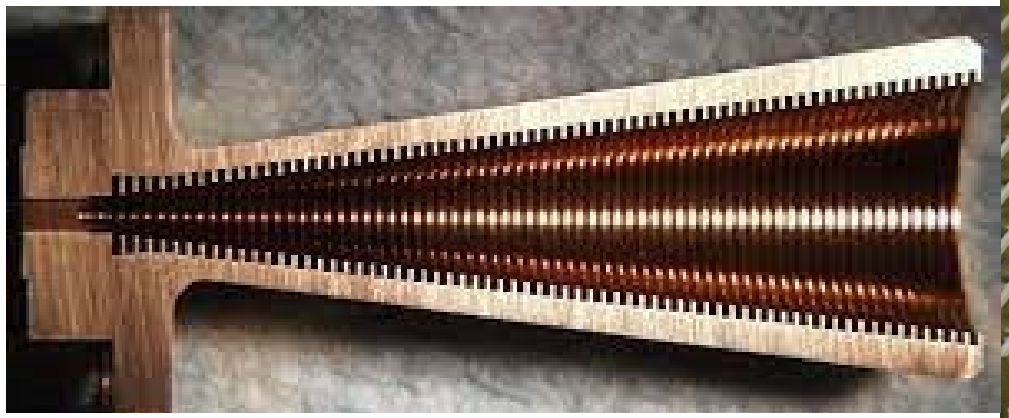


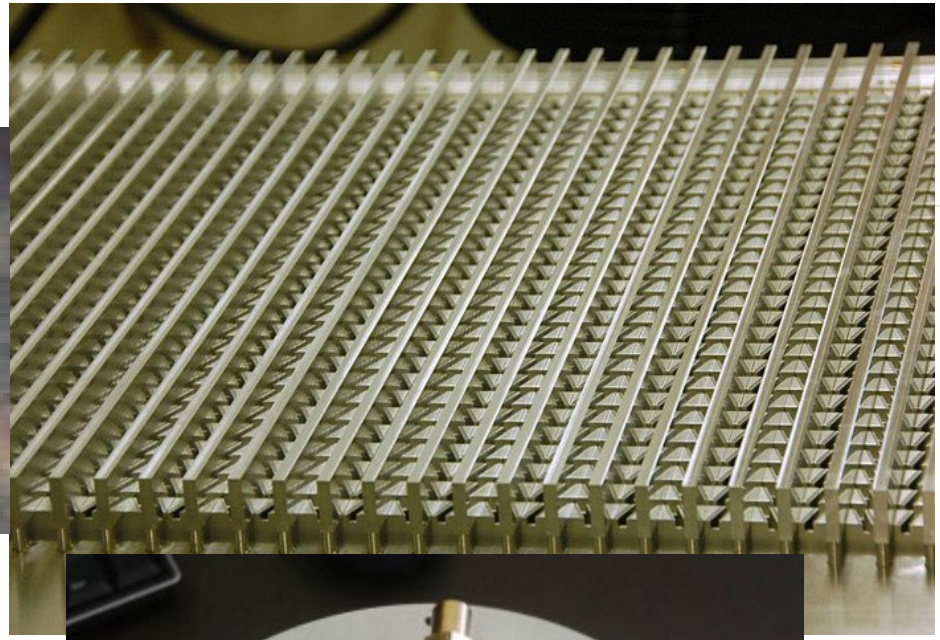


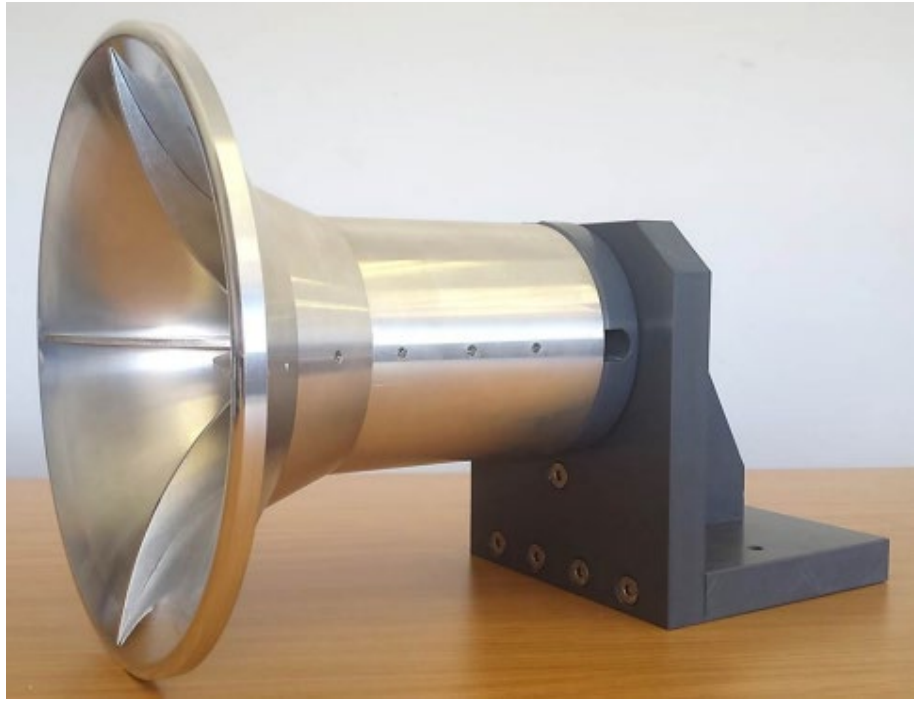


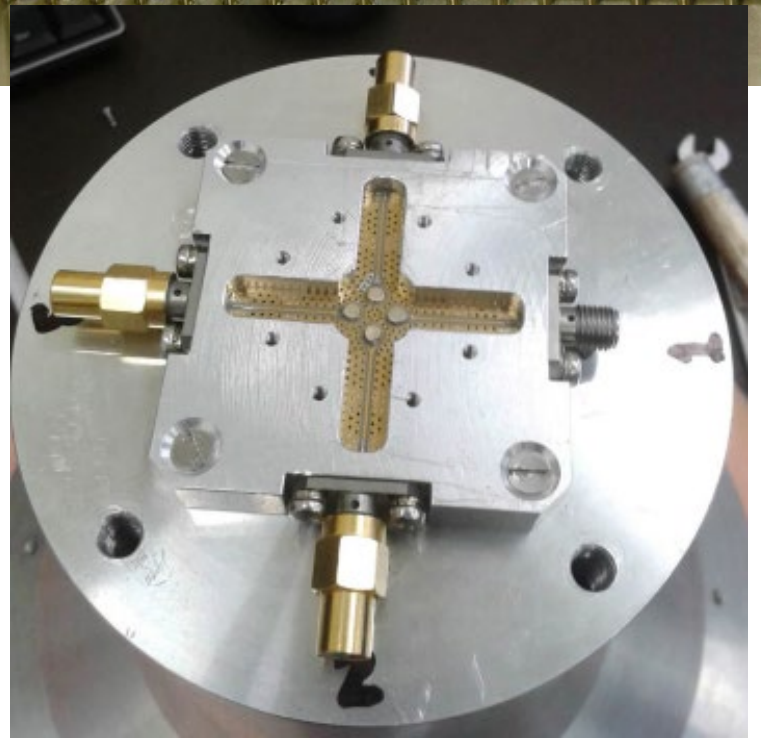


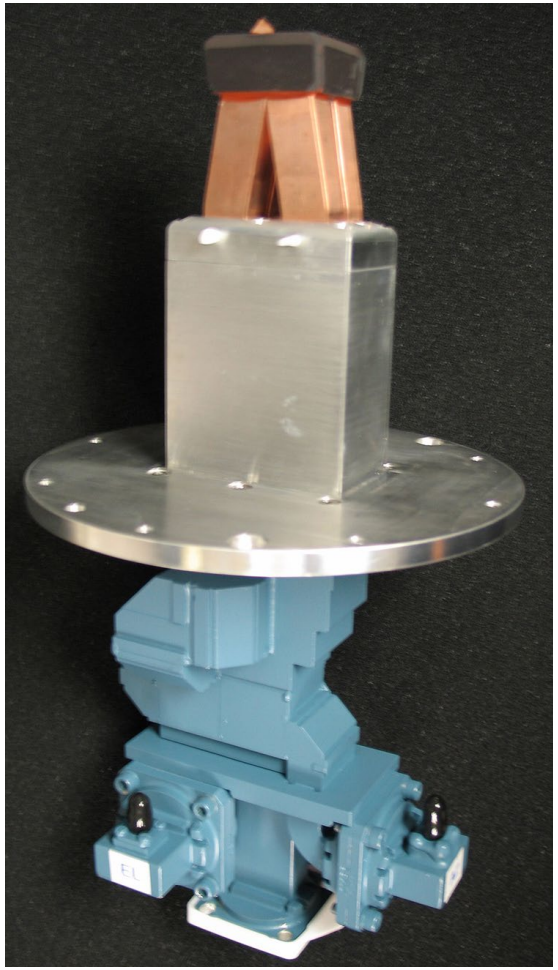
What is the problem?











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What is the problem?

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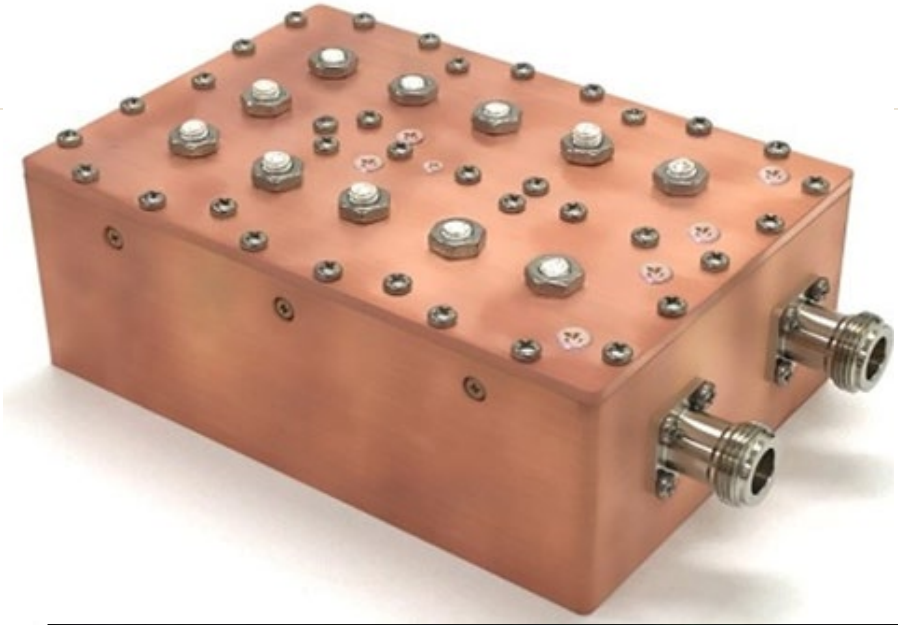

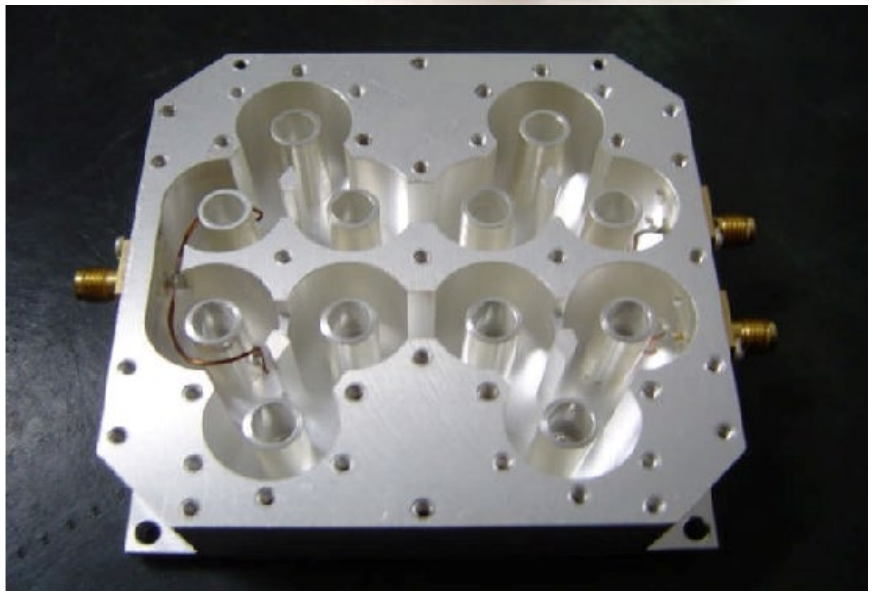

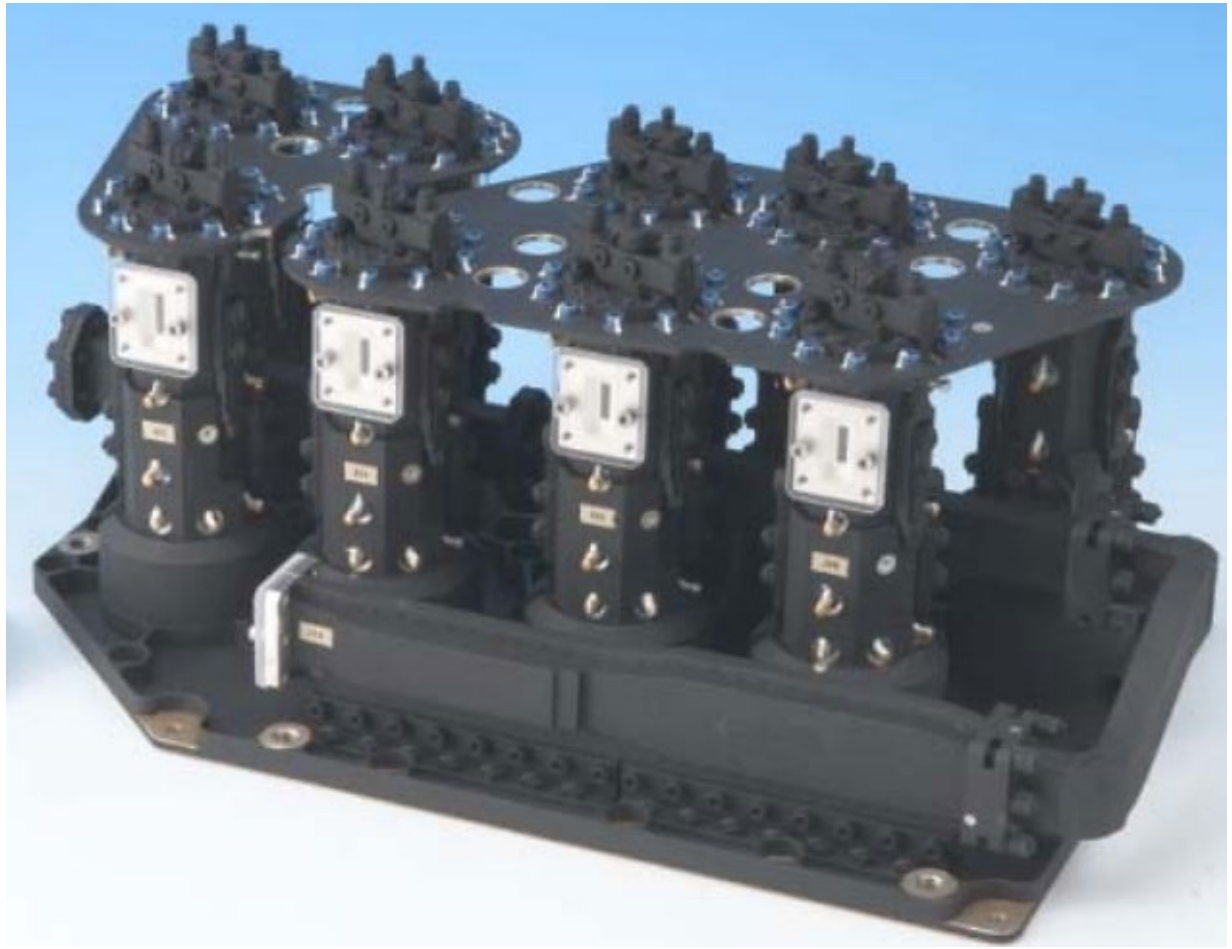

Normal design procedure - with tuning

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3D solver	• Decide on filter topology
	• Calculate initial dimensions
x 1	• Combine elements - assume 0% tolerance
x n	• Fine tuning by hand
x N	• Optimization process
x n	• Add tuning elements

Design procedure - no tuning

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3D solver	• Decide on filter topology
	• Calculate initial dimensions
x 1	• Combine elements - assume 0% tolerance
x n	• Fine tuning by hand
x N	• Optimization process
x NN	• Yield analysis – Monte Carlo

How can we improve that?

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- Polynomial Chaos Expansion (PCE)

Surrogate modelling technique that represents a **system performance parameter** in terms of orthogonal polynomial expansions of **random system parameters**

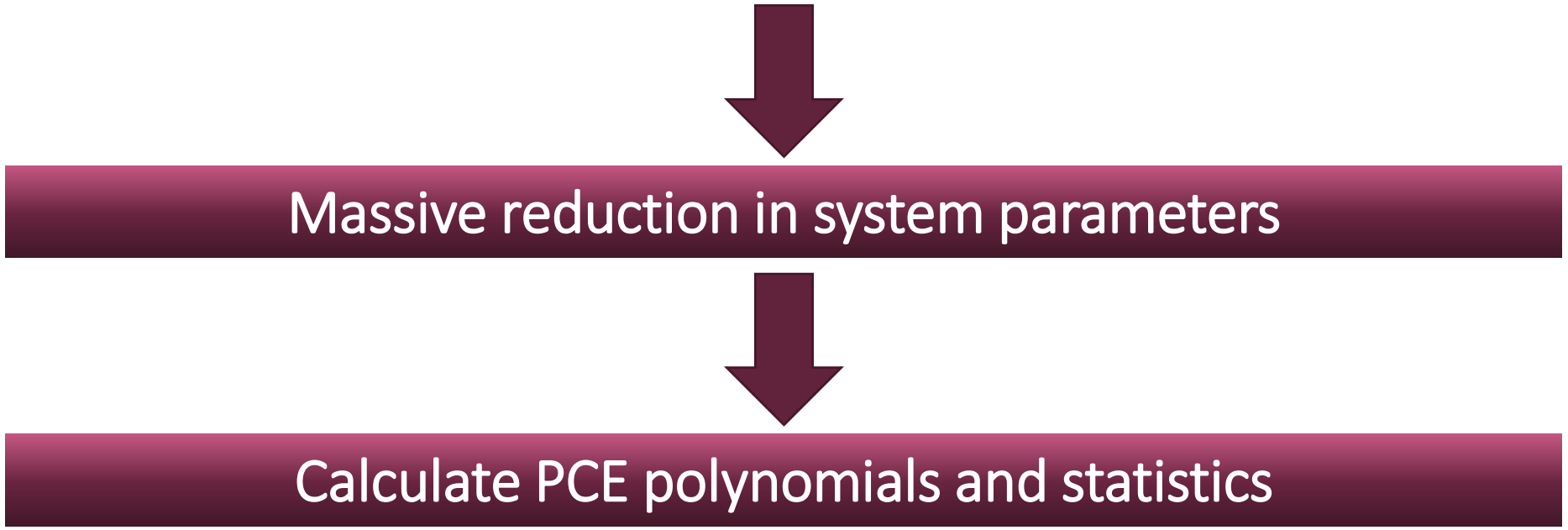
$$\hat{y}(x) = \sum_{k=0}^{N} c_k \phi_{\bar{k}}(x)$$

Mean Estimation	Variance Estimation	Yield Estimation
$\approx c_0 \alpha_0$	$\approx \sum_{k=1}^{P} c_k^2 \alpha_k^2$	Only requires Mean and Variance

How can we improve that?

- Non-Linear Partial-Least-Squares (NLPLS)

is a meta-modelling method that attempts to find relations between observable system parameters and **latent variables** (inferred variables)



Example: L-band Diplexer 37 parameters

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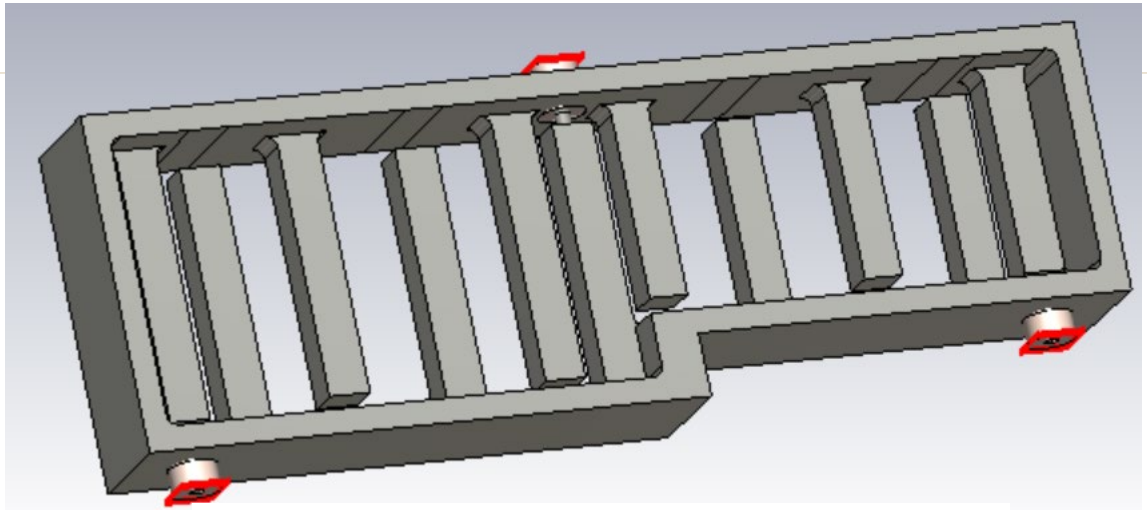
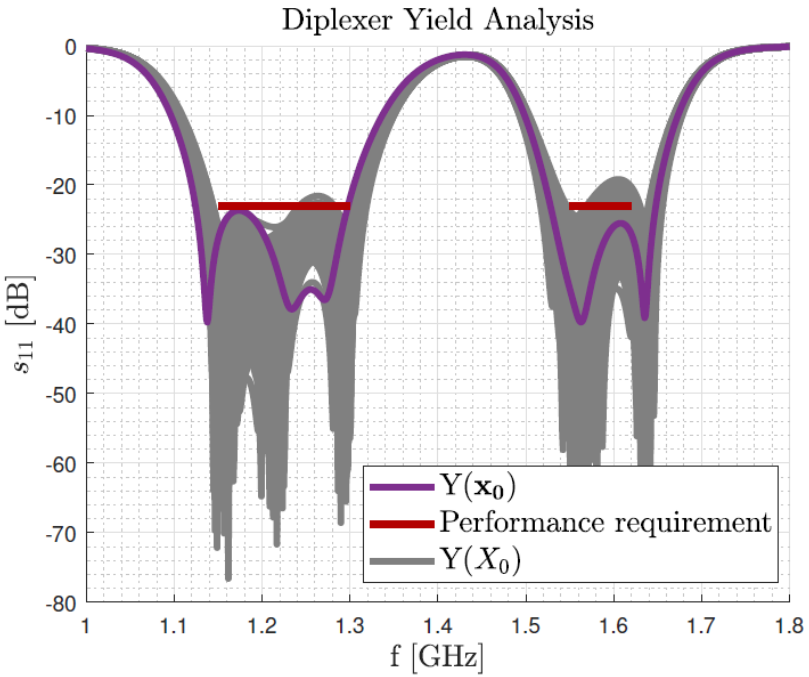
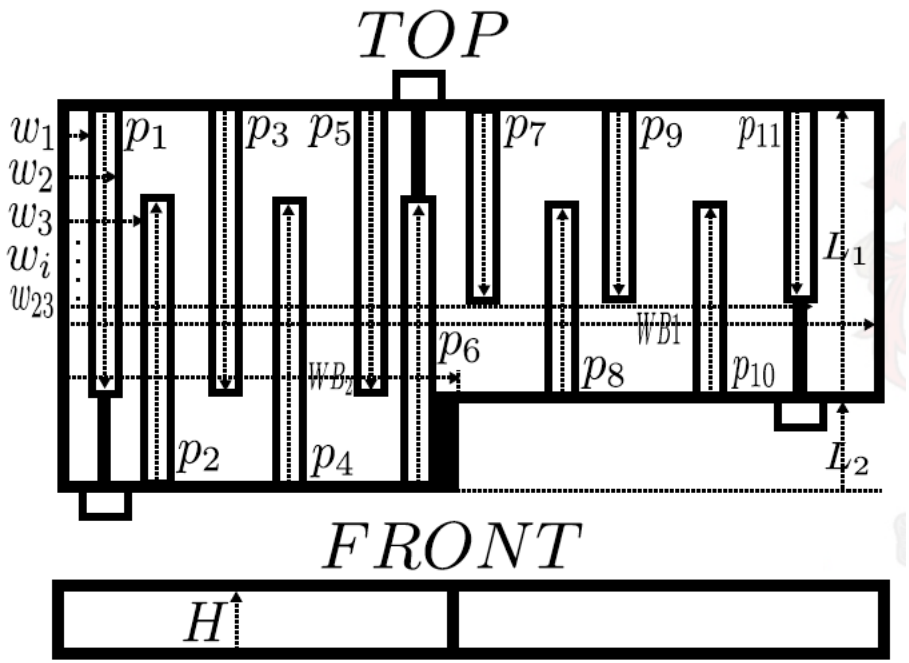
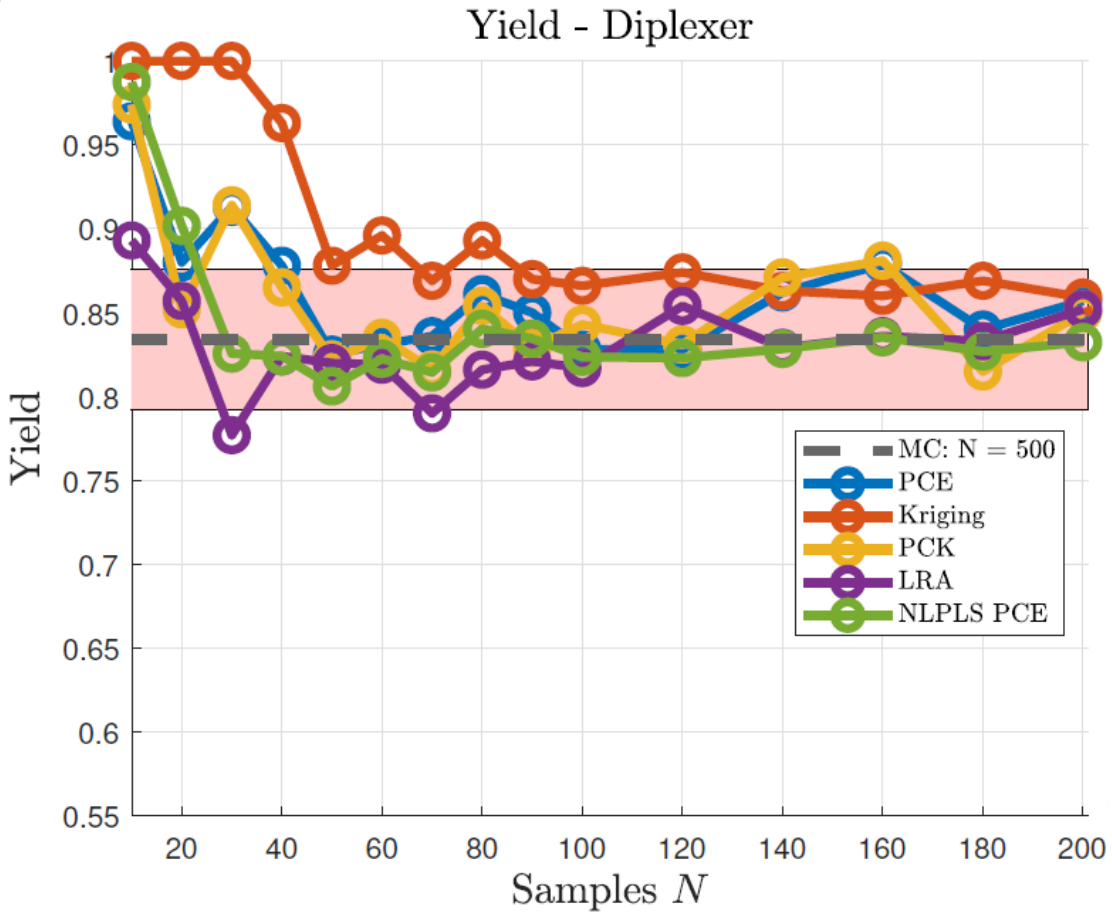
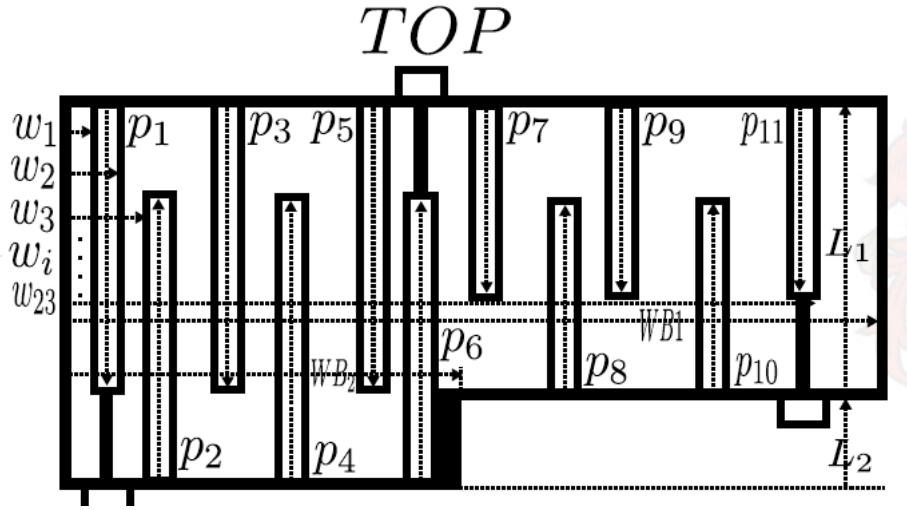


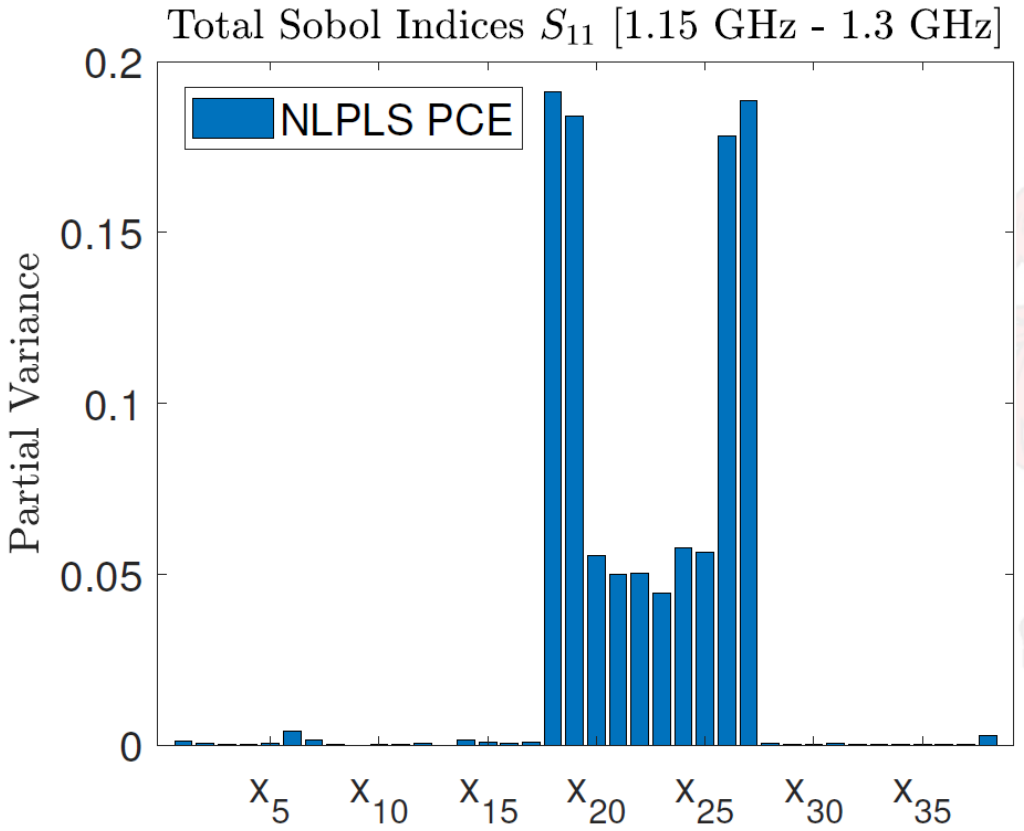




Example: L-band Diplexer 37 parameters







Future: Optimization for Yield

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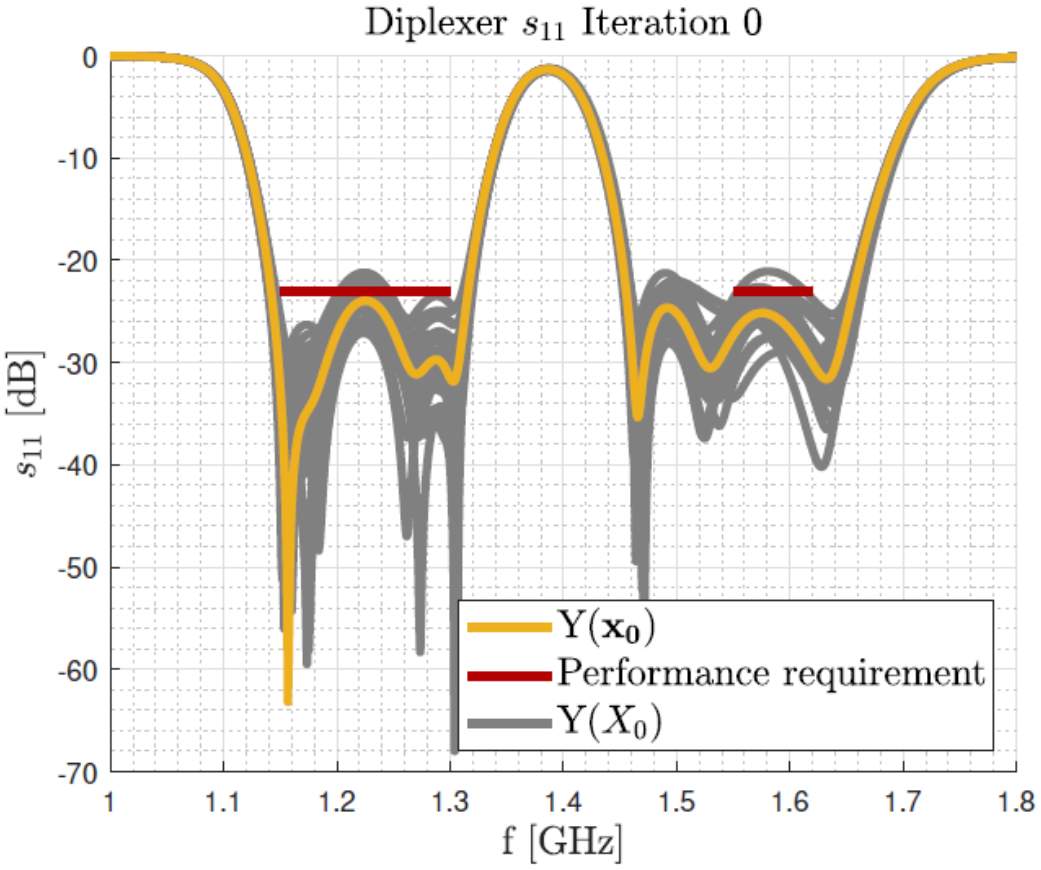

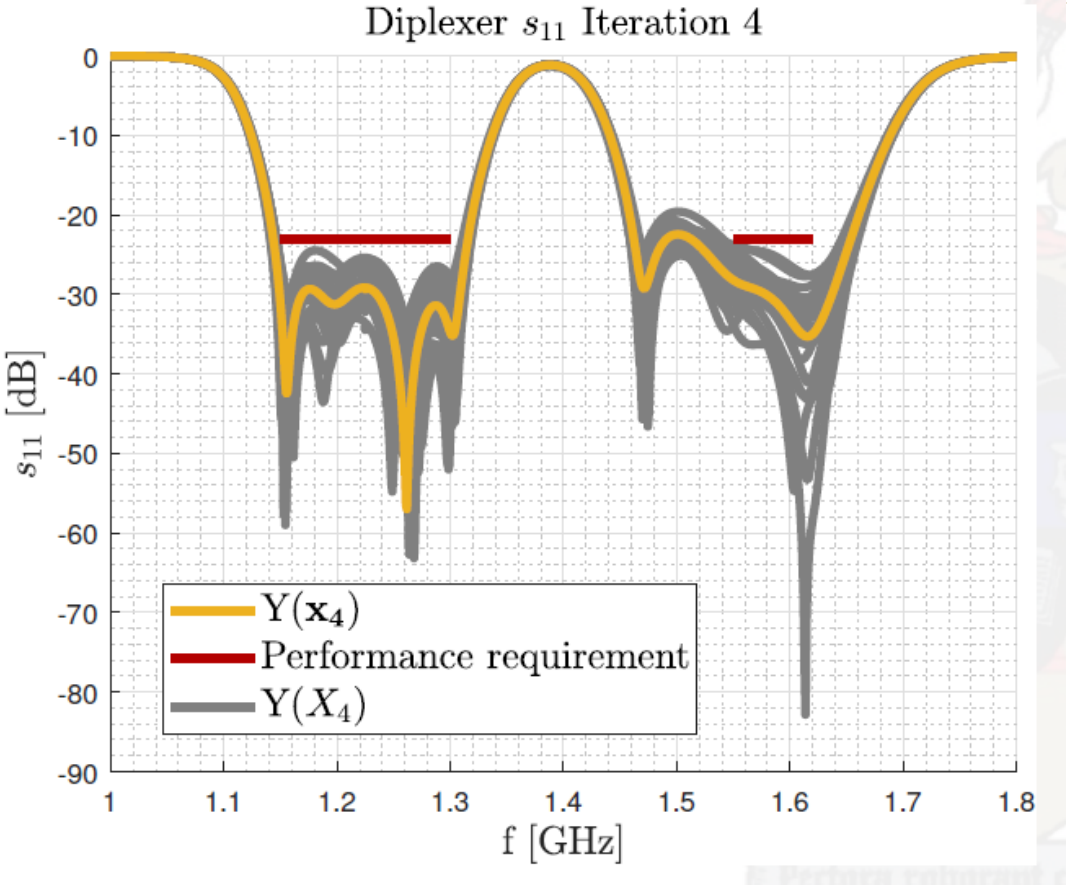

100% yield after 5 iterations – less than 200 3D Solver runs!

The End

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Thank you for your attention