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Synthesis method for matching filters

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SYNTHESIS METHOD FOR MATCHING FILTERS

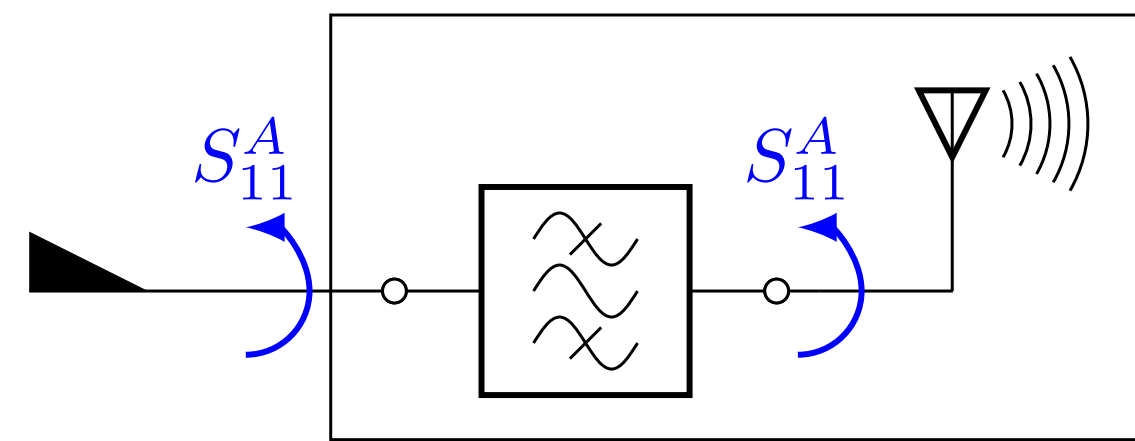
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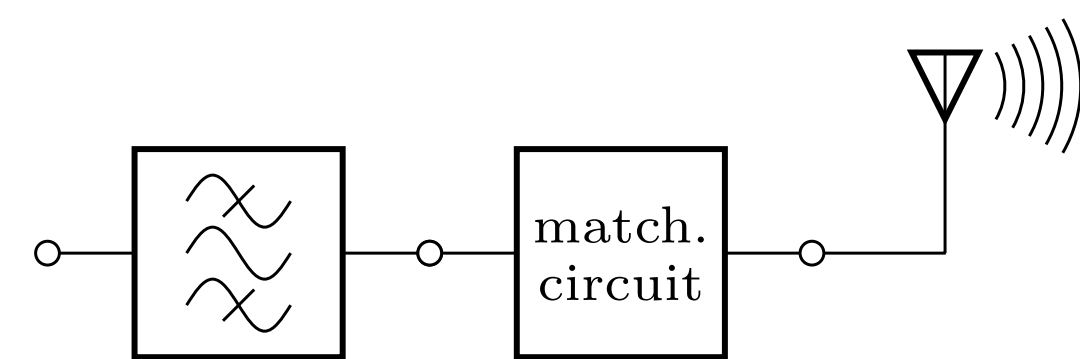
²XLIM Université de Limoges

1. STATUS QUO

NEGLECT ANTENNA MISMATCH



OR USE MATCHING NETWORKS

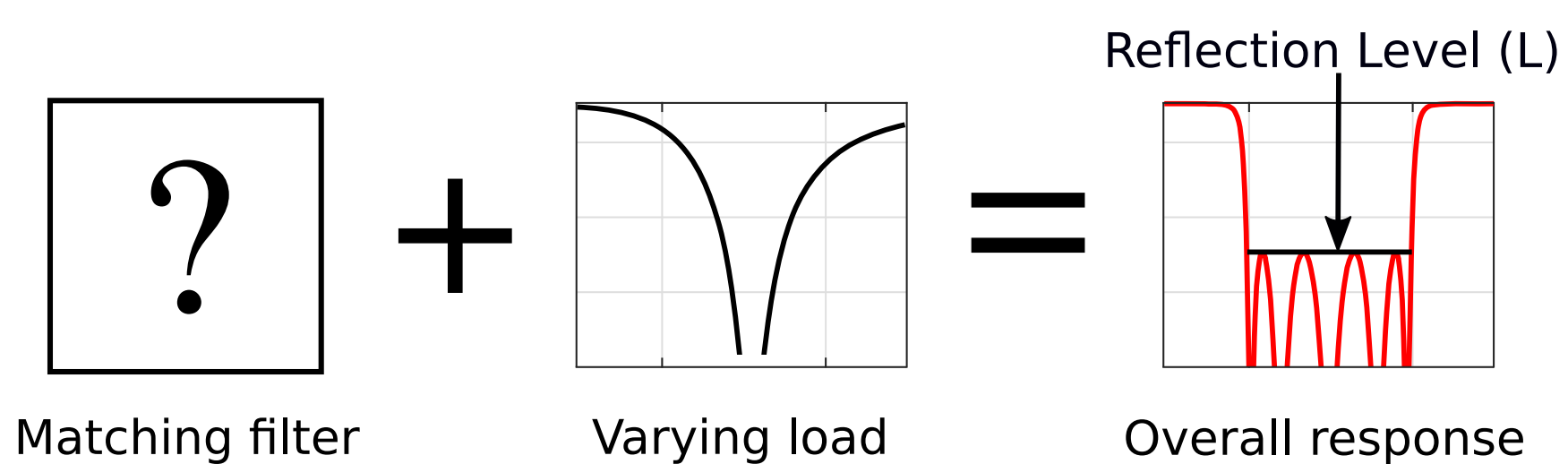


2. NEW INSIGHTS

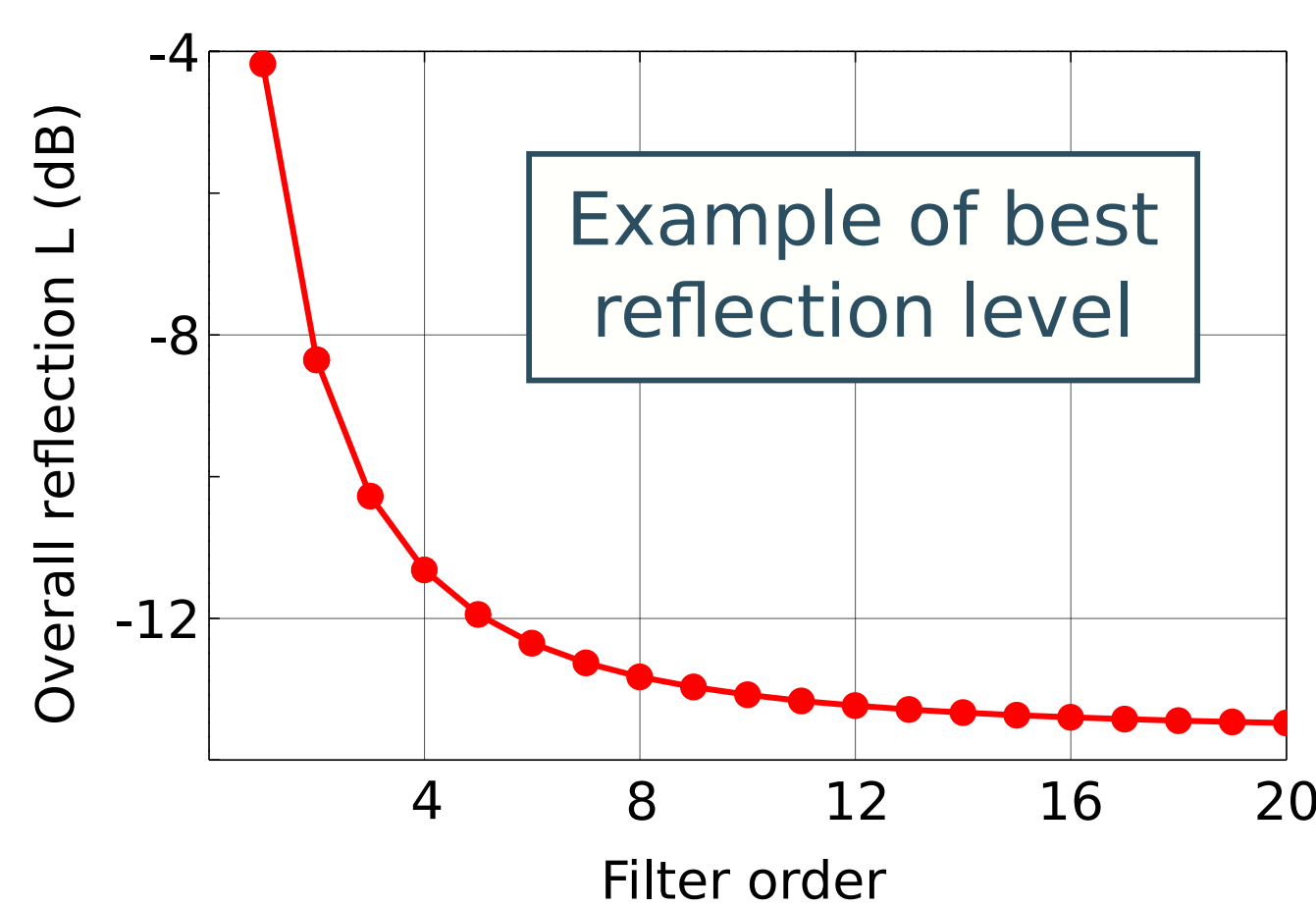
MATCHING FILTER SYNTHESIS

Compute filter that minimises overall reflection

Miniaturization: FILTERING + MATCHING



Load of degree 1 → **Optimal matching** can be computed!

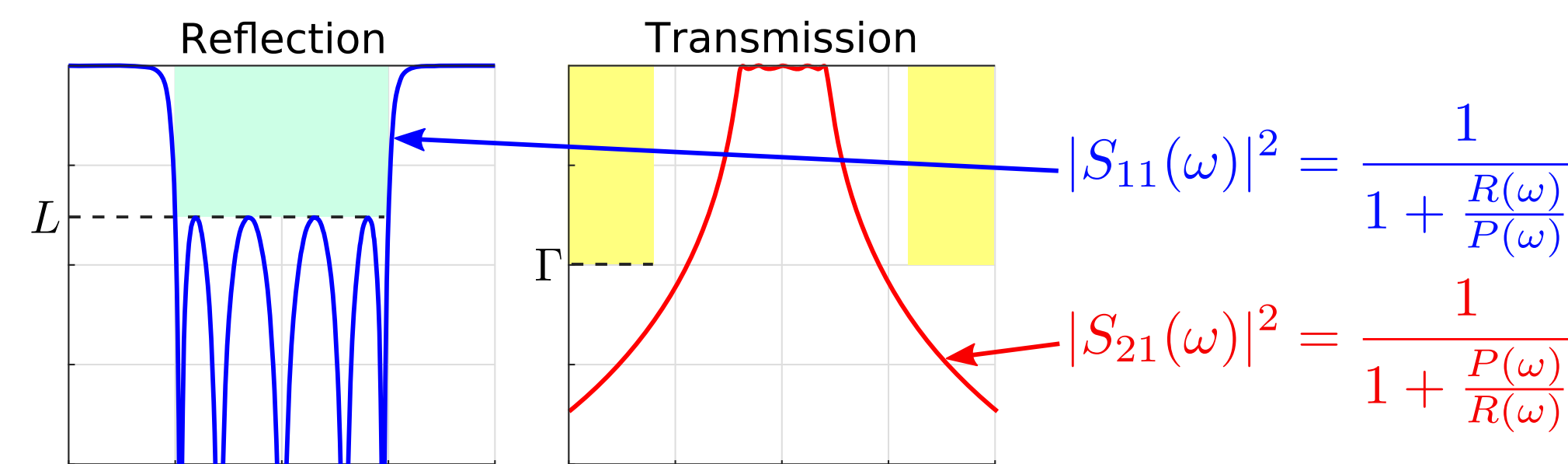


Asymptotic as filter order increases

↓
Fano bound

3. DESCRIPTION

TRADITIONAL: CONSTANT LOAD



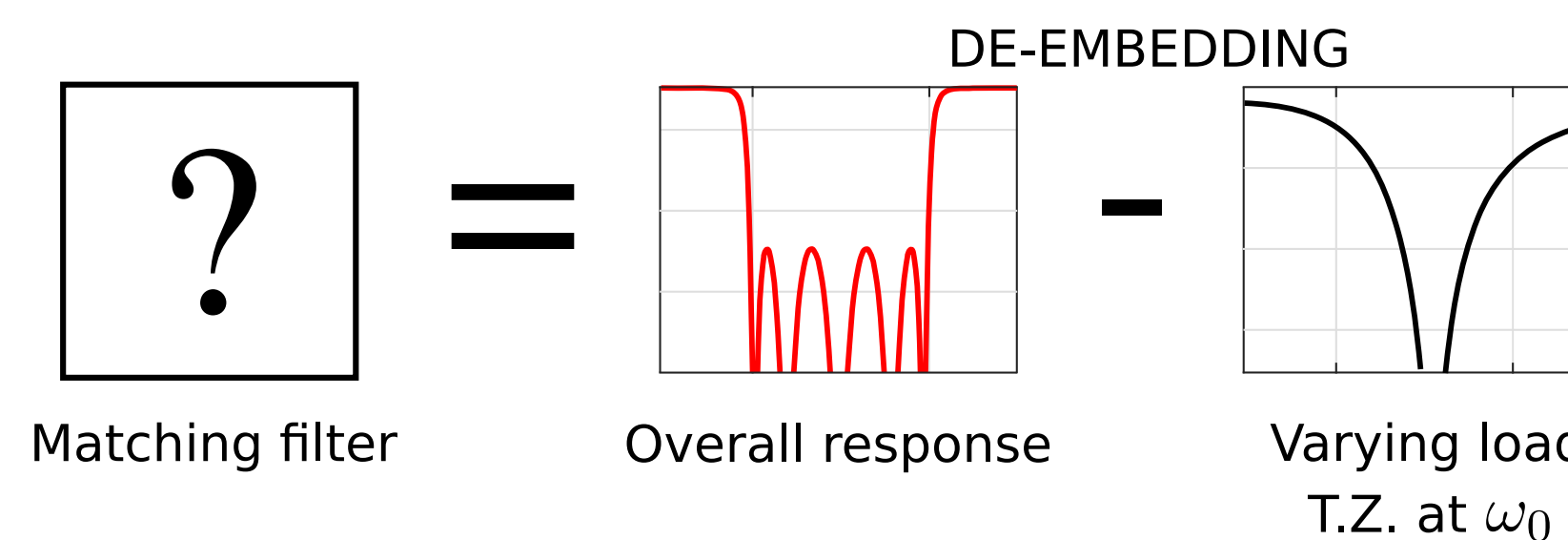
Classical synthesis problem:

Find: $\min_P L$
 Subject to: $P(\omega) \leq LR(\omega) \quad L \geq 0 \quad \omega \in \text{Passband}$
 $P(\omega) \geq \Gamma R(\omega) \quad \Gamma \geq 0 \quad \omega \in \text{Stopband}$

with P,R: non-negative polynomials.

NEW: FREQUENCY-VARYING LOAD

Overall design ensuring de-embedding of the load



Matching synthesis problem:

Find: $\min_P L$
 Subject to: $P(\omega) \leq LR(\omega) \quad L \geq 0 \quad \omega \in \text{Passband}$
 $P(\omega) \geq \Gamma R(\omega) \quad \Gamma \geq 0 \quad \omega \in \text{Stopband}$
 $f(P) \leq K \quad K \geq 0$

$f(P)$: guarantees stability K : depends on the load

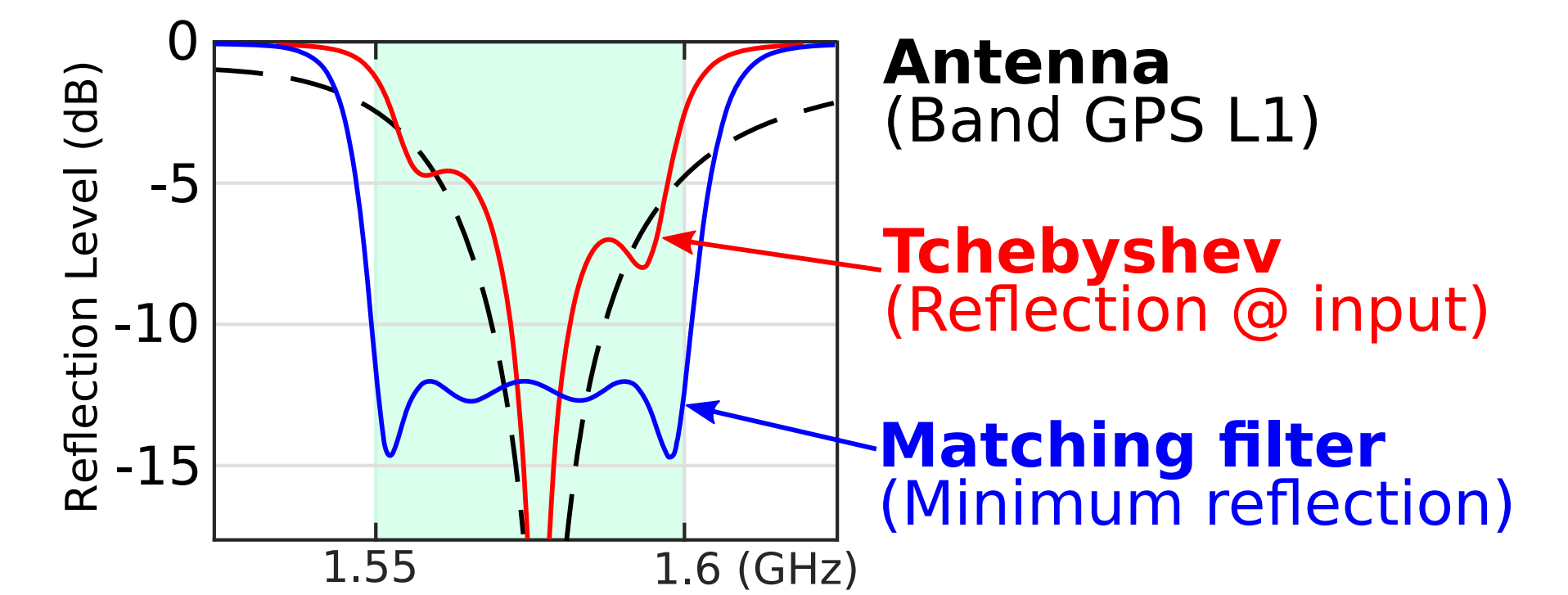
$$f(P) = \int_{\mathbb{R}} \left(1 - \frac{\omega}{\omega_0}\right)^{-2} \log \left(1 + \frac{R(\omega)}{P(\omega)}\right) d\omega$$

↓
Convex Function → **Convex Problem!**

4. QUANTITATIVE IMPACT

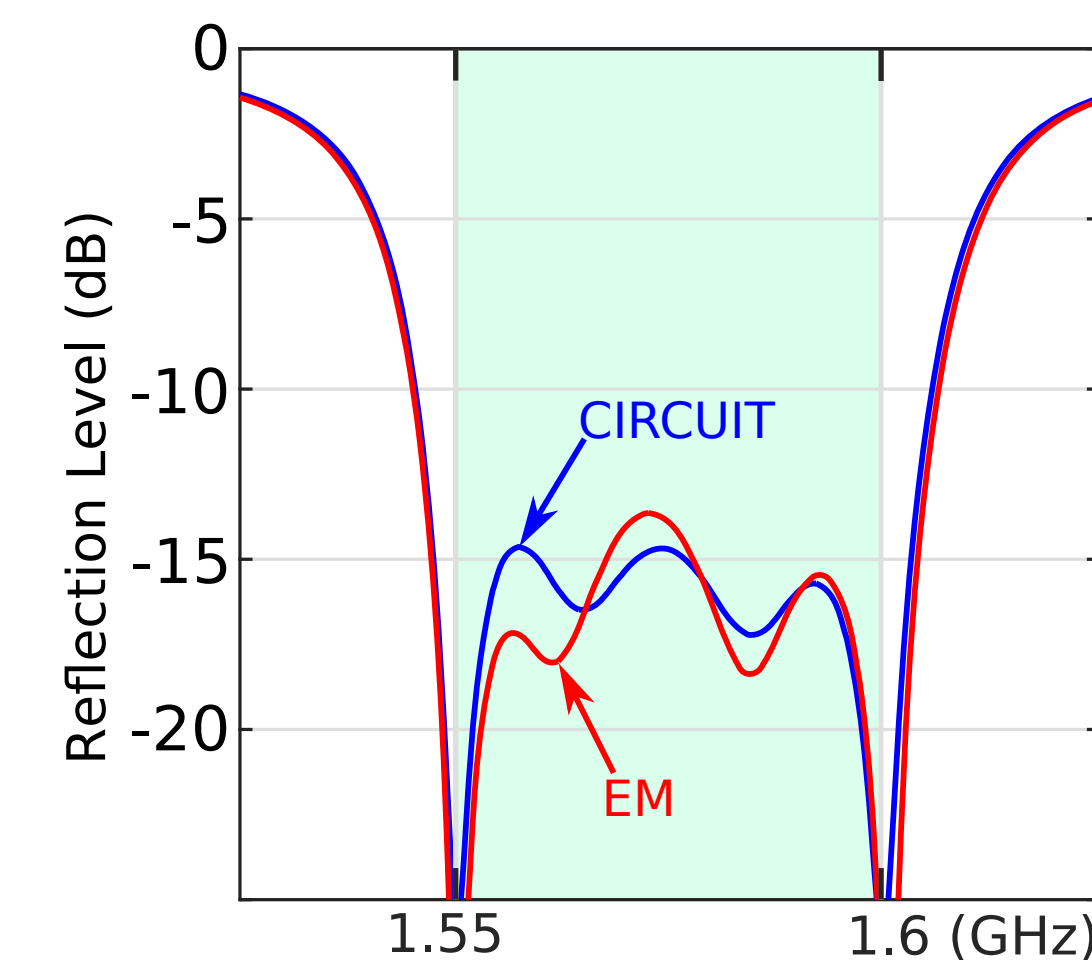
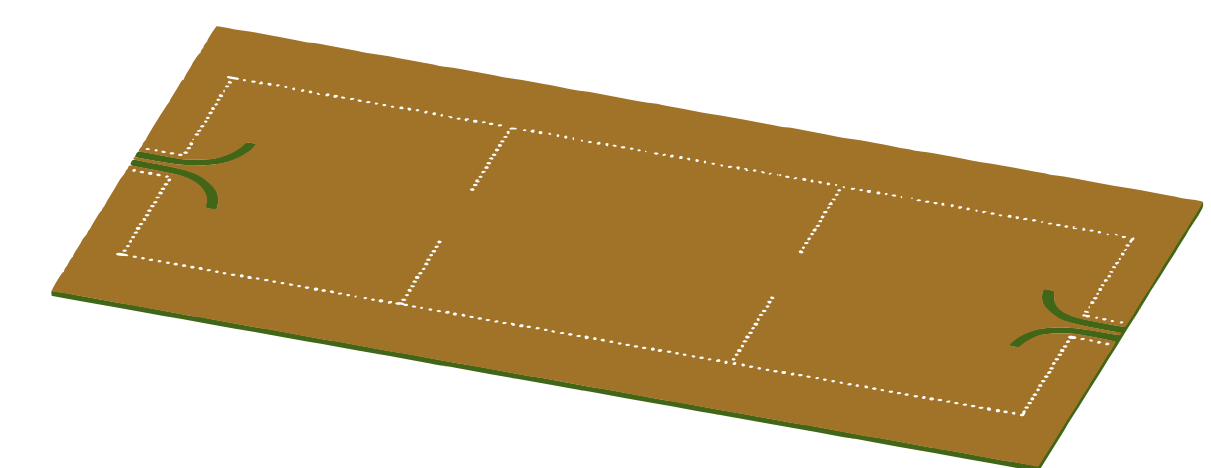
SYNTHESIS EXAMPLE

Filter of degree 3 for antenna of degree 1



SIMULATION RESULTS

Implementation in SIW technology of the de-embedded matching filter.



Overall response
Response of degree 4 with filter of degree 3

Improved efficiency & Reduced footprint

5. CONCEPT GOALS

CONCLUSION

Synthesis: Frequency-varying load \equiv constant load
 Optimal finite degree matching filter is computed

ONGOING WORK

Higher degree loads
 Synthesis tool for OMUX

