Synthesis method for matching filters

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SYNTHESIS METHOD FOR MATCHING FILTERS

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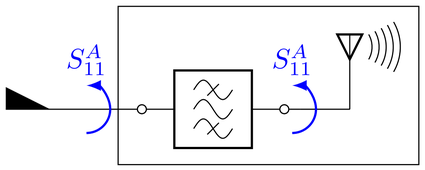
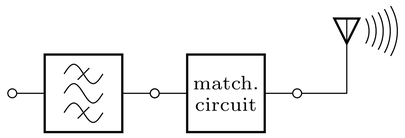
IMS Connecting Minds. Exchanging Ideas.

1. STATUS QUO

NEGLECT ANTENNA MISMATCH



OR USE MATCHING NETWORKS

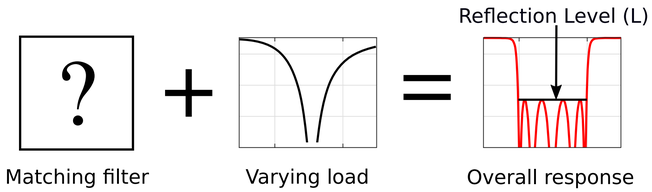


2. NEW INSIGHTS

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

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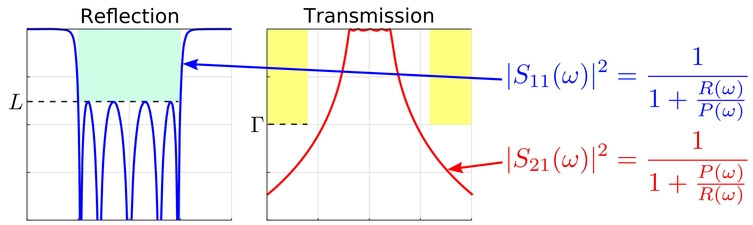
Fano bound

3. DESCRIPTION

TRADITIONAL: CONSTANT LOAD



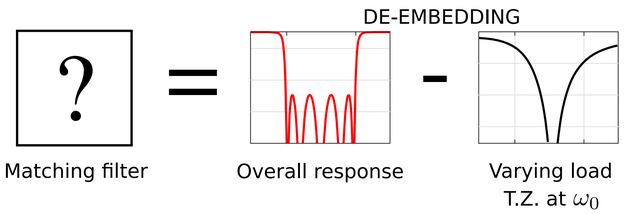
Classical synthesis problem:

$$\begin{aligned} &\text{Find:} && \min_P L \\ &\text{Subject to:} && P(\omega) \le LR(\omega) && L \ge 0 && \omega \in \text{Passband} \\ &&& P(\omega) \ge \Gamma R(\omega) && \Gamma \ge 0 && \omega \in \text{Stopband} \end{aligned}$$

with P,R: non-negative polynomials.

NEW: FREQUENCY-VARYING LOAD

Overall design ensuring de-embedding of the load



Matching synthesis problem:

$$\begin{aligned} &\text{Find:} && \min_P L \\ &\text{Subject to:} && P(\omega) \le LR(\omega) && L \ge 0 && \omega \in \text{Passband} \\ &&& P(\omega) \ge \Gamma R(\omega) && \Gamma \ge 0 && \omega \in \text{Stopband} \\ &&& f(P) \le K && K \ge 0 \end{aligned}$$

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

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

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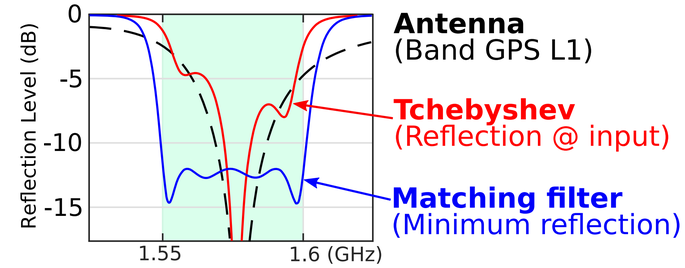
Convex Function → ***Convex Problem!***

4. QUATITATIVE IMPACT

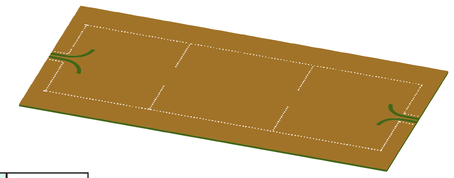
SYNTHESIS EXAMPLE

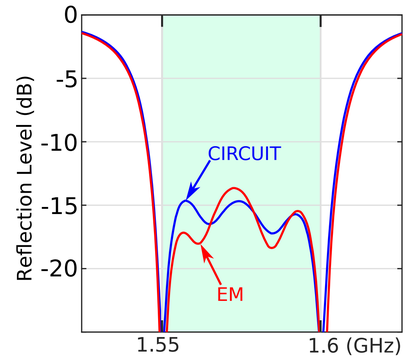
Filter of degree 3 for antenna of degree 1



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 ≡ constant load

Optimal finite degree matching filter is computed

ONGOING WORK

Higher degree loads

Synthesis tool for OMUX