EDISON

Electromagnetic Design of
flexIble SensOrs

FNP Team-Tech

Report 12 - Multiparametric MOR studies

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1.0	22.08.2017		created

1. Basic infromation

The aim of this report is to check how different projection bases are working for multiparametric simulations of simple geometry.

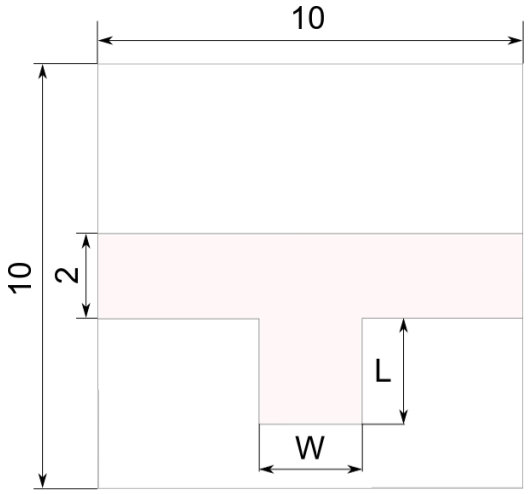

Figure 1: Structure under analysis. ≈40k variables

Structure under consideration is simple microwave stub with dimensions shown in Fig. 1 using $h = 0.5mm$, $\epsilon_r = 3.5$ substrate. Lumped ports and ABC conditions are applied.

1.1. Case A - varying width

The reference point for creating mesh is located at W=2.5 and L=2.5. After that MeshMorphing is applied, and points in range of W=2.4 to W=2.49 (starting from W=2.49) at L=2.49 with step 0.01 are considered (total 10 points).

1.2. Case B - varying length

The reference point for creating mesh is located at W=2.5 and L=2.5. After that MeshMorphing is applied, and points in range of L=2.4 to L=2.49 (starting from L=2.49) at W=2.49 with step 0.01 are considered (total 10 points).

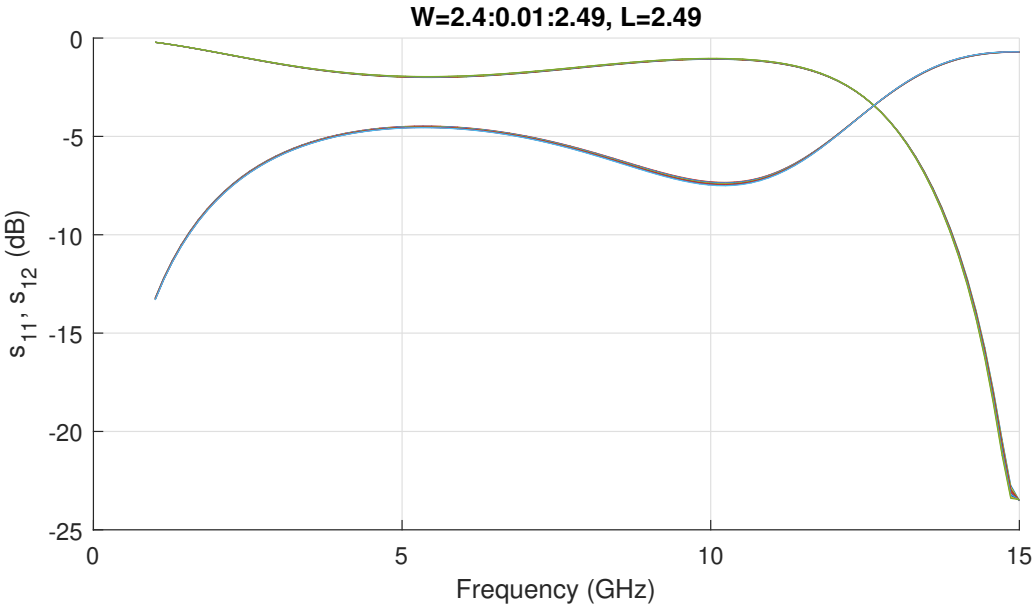

Figure 2: **Case A**. Family of curves varying **from W=2.4 to W=2.49** with step 0.01 (total number=10). Insignificant changes are observed between subsequent series.

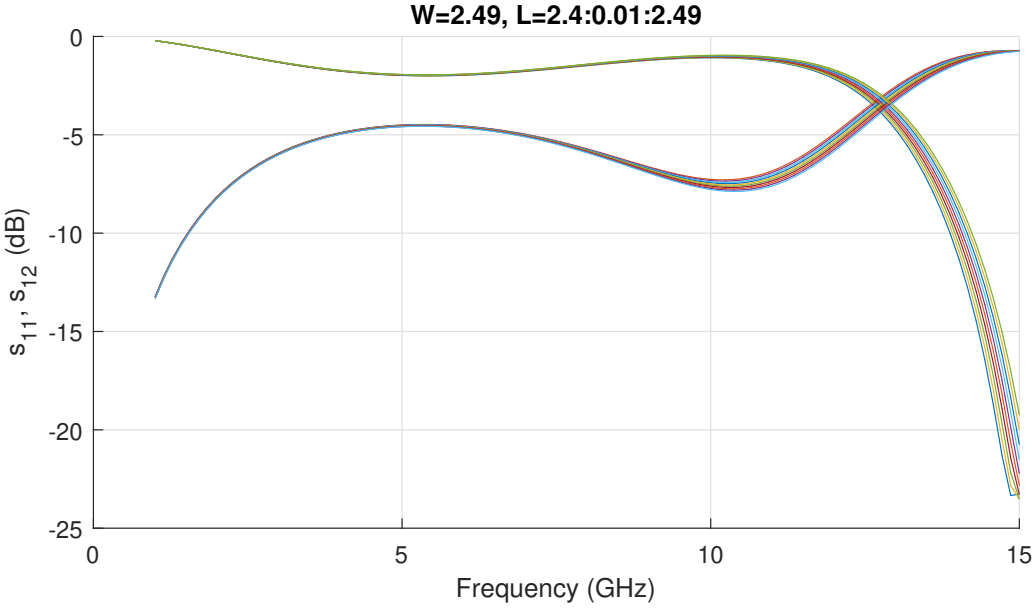

Figure 3: **Case B**. Family of curves varying **from L=2.4 to L=2.49** with step 0.01 (total number=10). Significant changes are observed between subsequent series (in comparison to previous case).

2. Reference simulations

The aim of this section is to compare scattering parameters obtained with **DIRECT** simulation with and without Mesh Morphing. The difference in number of elements is negligible ($\approx$ 1%), but the difference between obtained results saturates from around 1e-4 at lowest frequency (1 GHz) to around 1e-2 at highest frequency (15 GHz). Adaptive meshing **is not** used in these cases.

2.1. Case A - varying width of stub

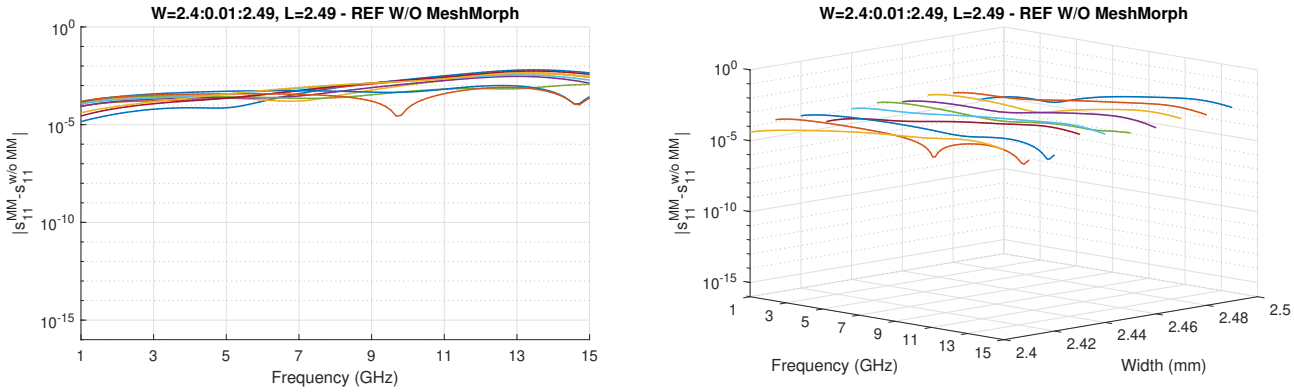

Figure 4: Error between reference characteristics with MeshMorphing and reference characteristics without MeshMorphing. **$\approx$40k variables**

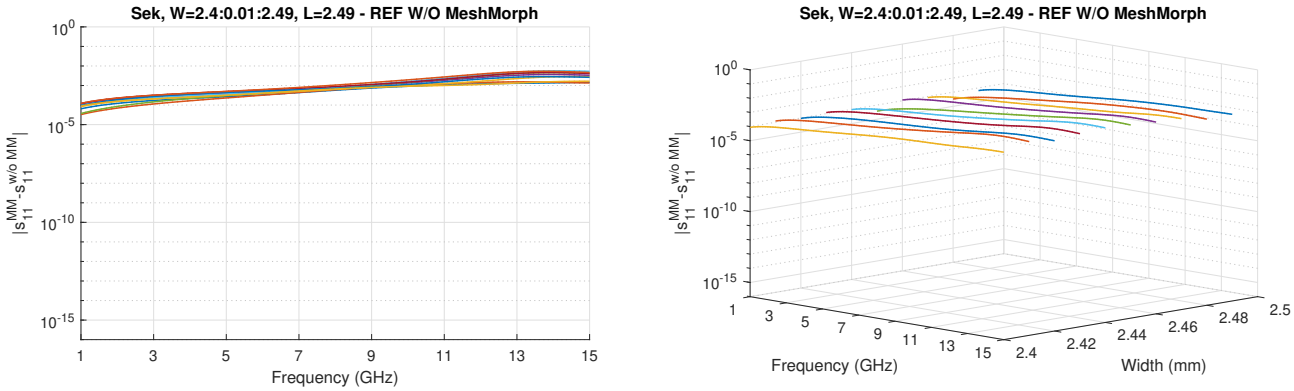

Figure 5: Error between reference characteristics with MeshMorphing and reference characteristics without MeshMorphing. **$\approx$200k variables**

2.2. Case B - varying length of stub

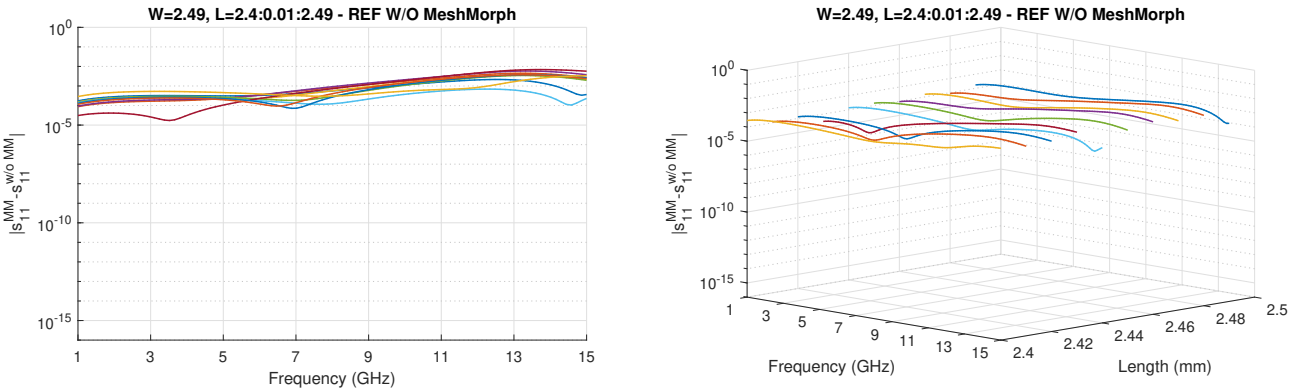

Figure 6: Error between reference characteristics with MeshMorphing and reference characteristics without MeshMorphing. **≈40k variables**

3. Model Order Reduction for multiparametric simulation

The aim of this sections is to verify if projection basis calculated at one point (assume W=2.47 for Case A and L=2.47 for Case B) can be used at other points (using mesh morphing technique starting from W=2.49 to W=2.4 for Case A and from L=2.49 to L=2.4 for Case B).

Up to four projection bases are concatenated, and SVD algorithm is used to orthogonalize them. All vectors are taken into consideration (no rejection threshold is introduced). Singular values of bases concatenated of four sub-bases (4x14 vecs, first subplot is 3x14 + 16) are shown in Fig. 7 for both cases.

After that InventSim is started using -lp mode (**Load Projection - LP** Basis) and using mesh morphing between subsequent points.

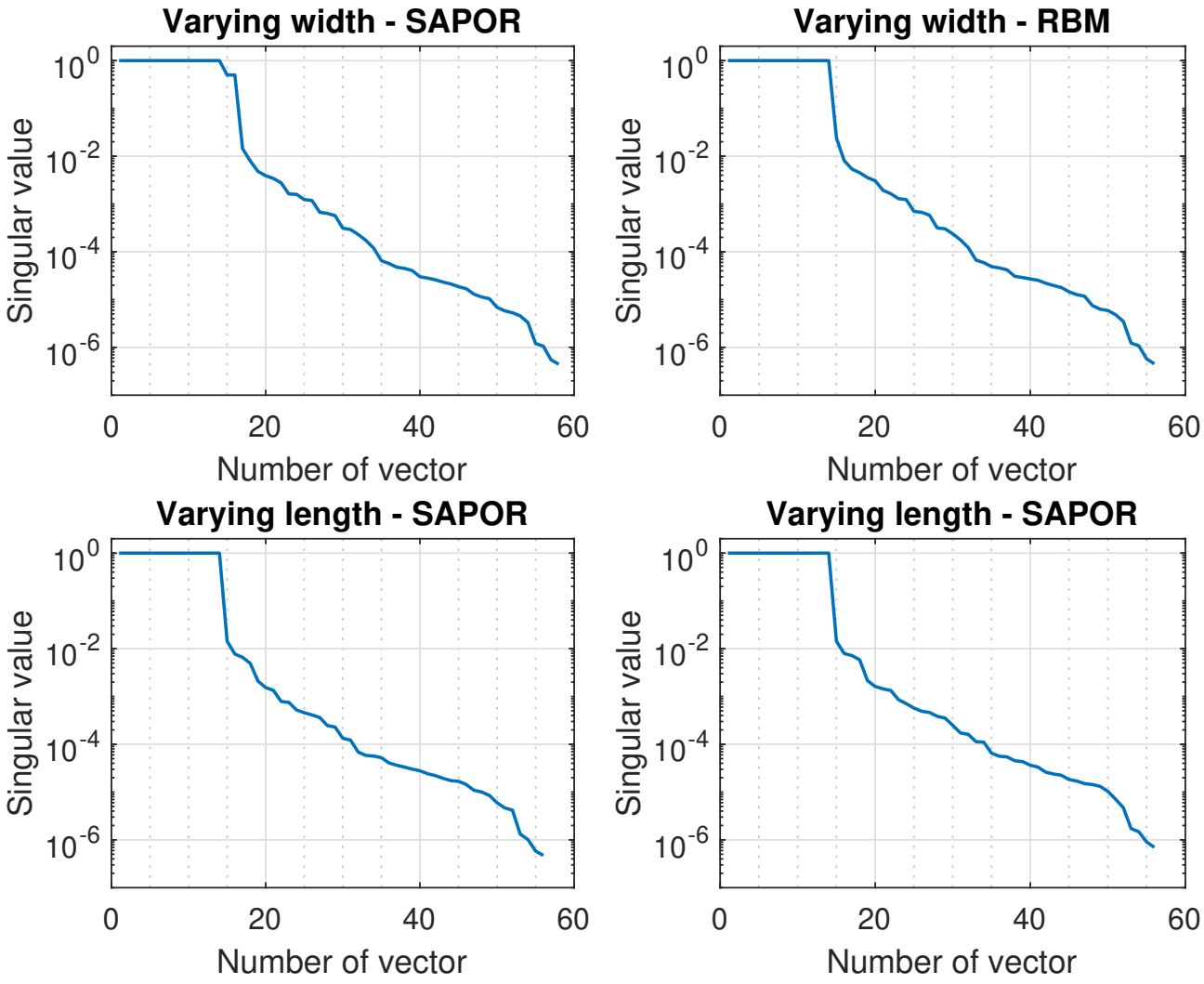

Figure 7: Singular values of concatenated bases at four points of W or L.

3.1. Case A - varying width of stub

3.1.1. Basis constructed using RBM

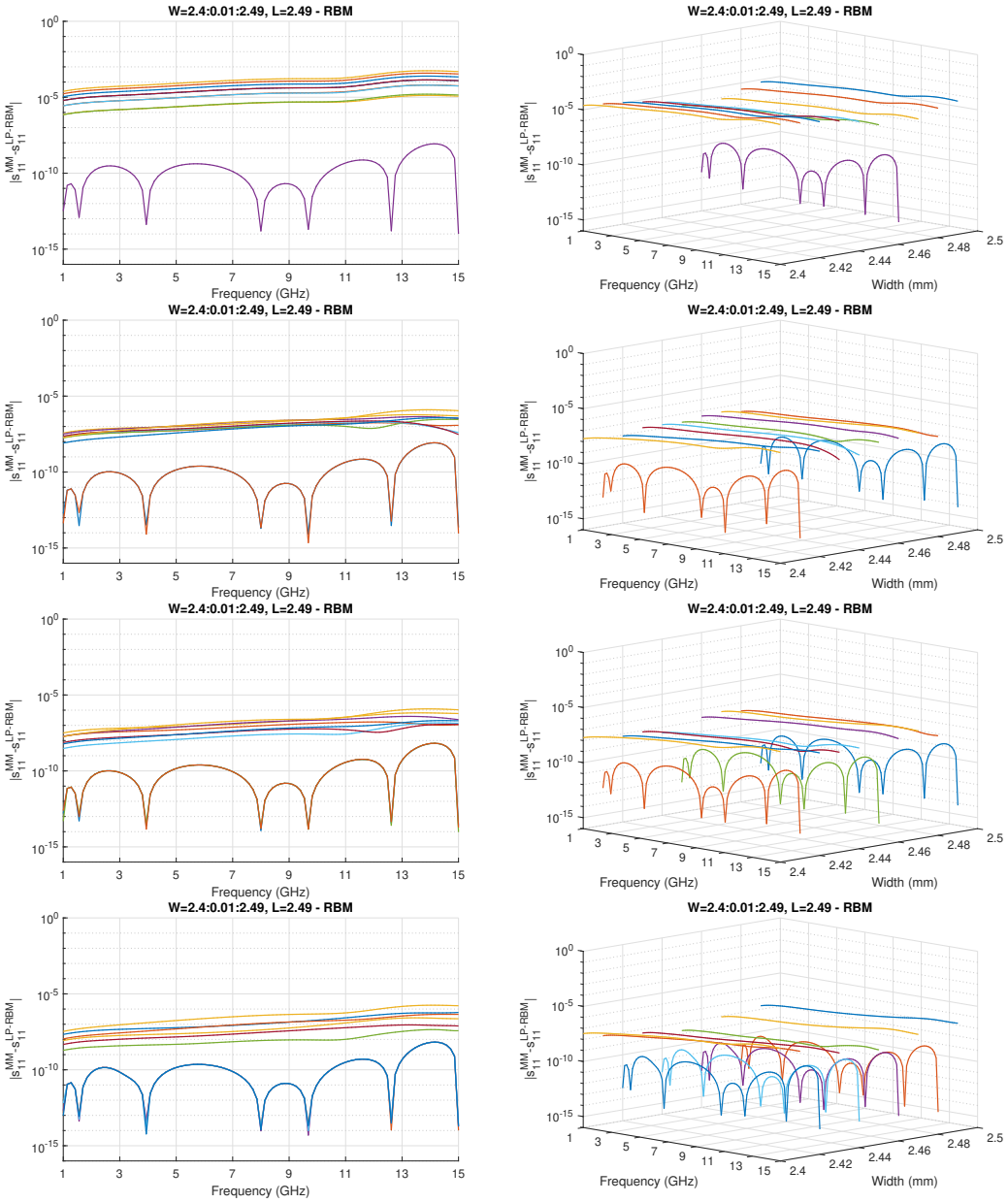

Figure 8: Actual error of s_{11} parameter for projection bases concantenated of 1/2/3/4 RBM bases.

3.1.2. Basis constructed using SAPOR

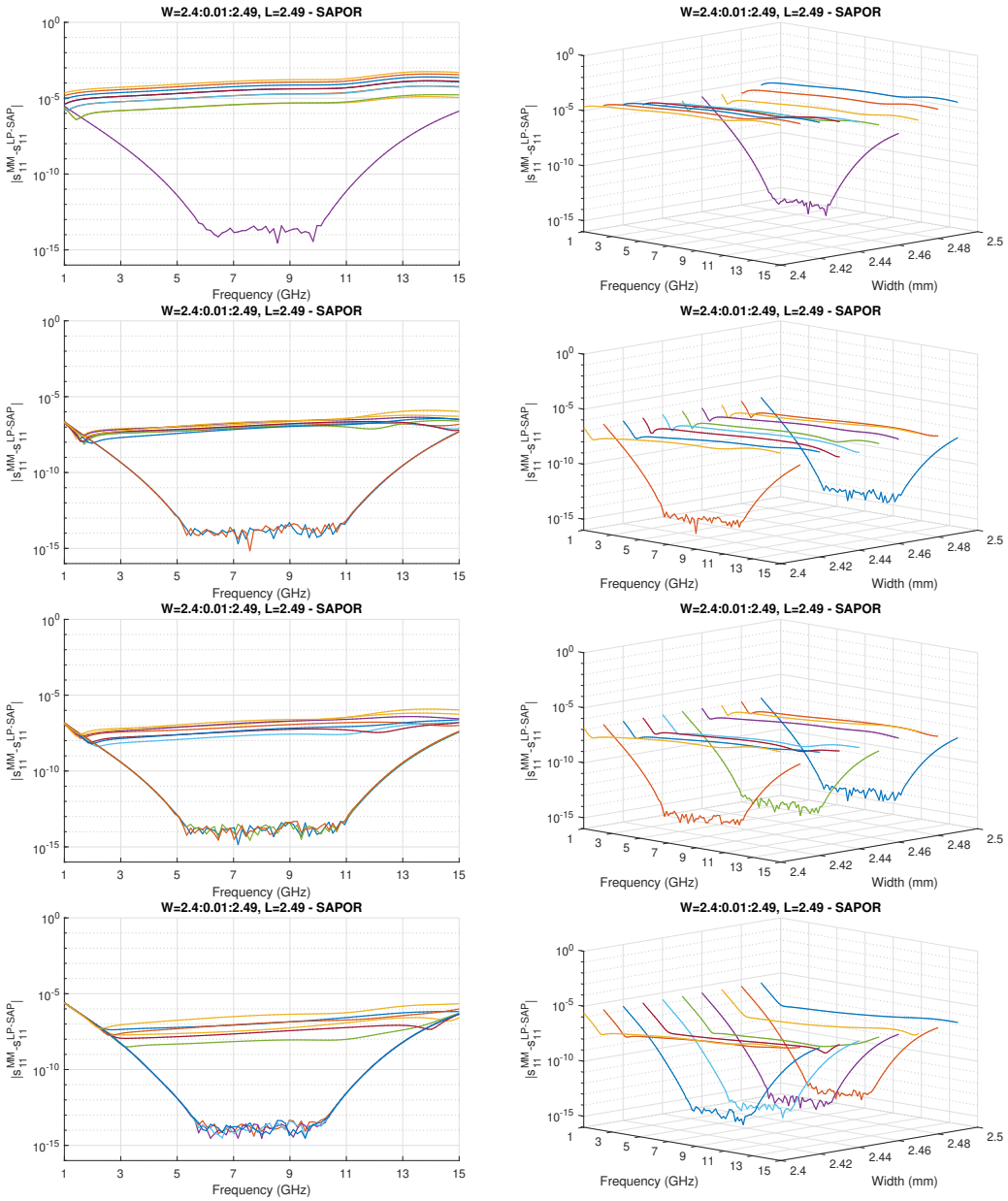

Figure 9: Actual error of s_{11} parameter for projection bases concantenated of 1/2/3/4 SAPOR bases.

3.2. Case B - varying length of stub

3.2.1. Basis constructed using RBM

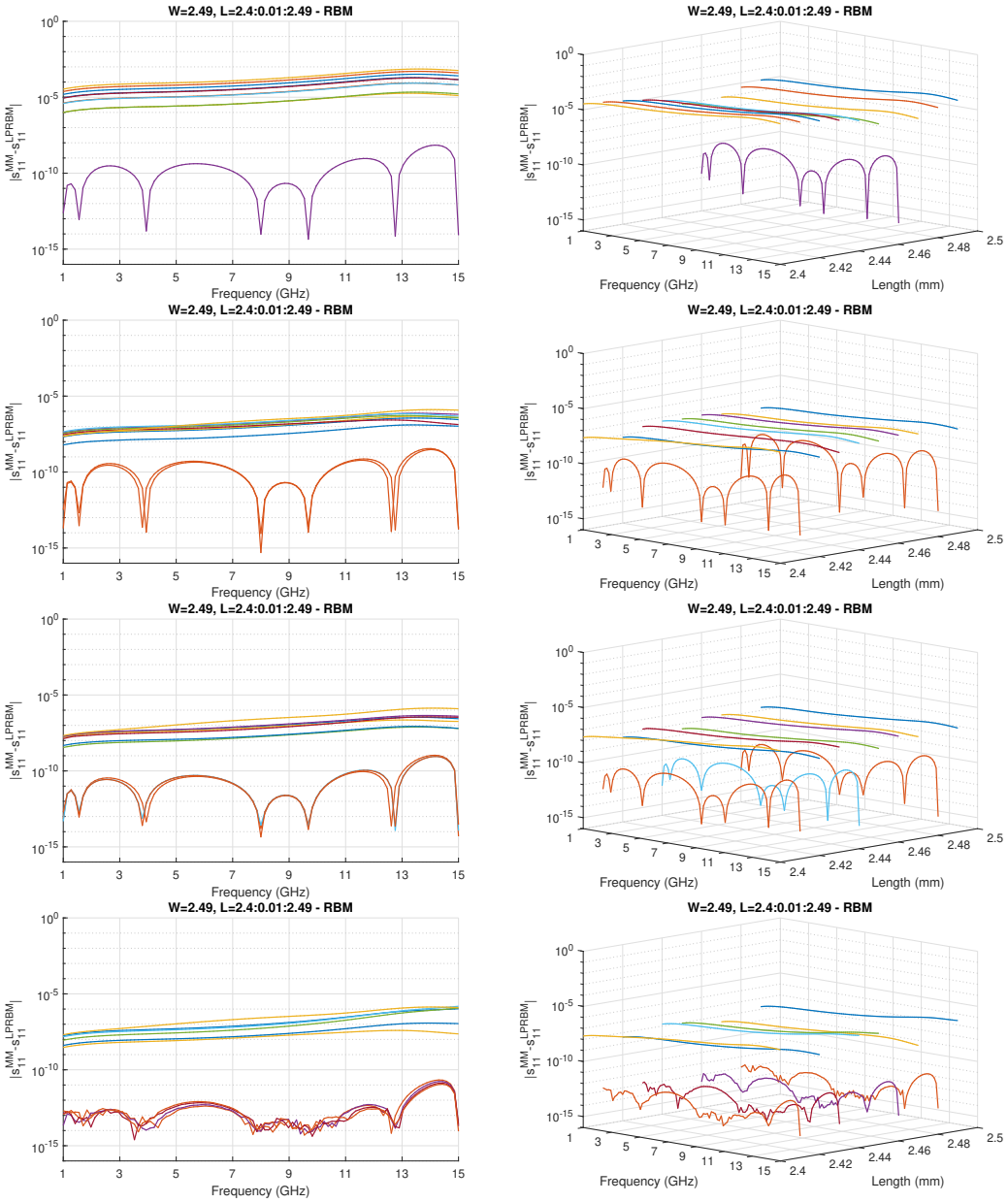

Figure 10: Actual error of s_{11} parameter for projection bases concantenated of 1/2/3/4 RBM bases.

3.2.2. Basis constructed using SAPOR

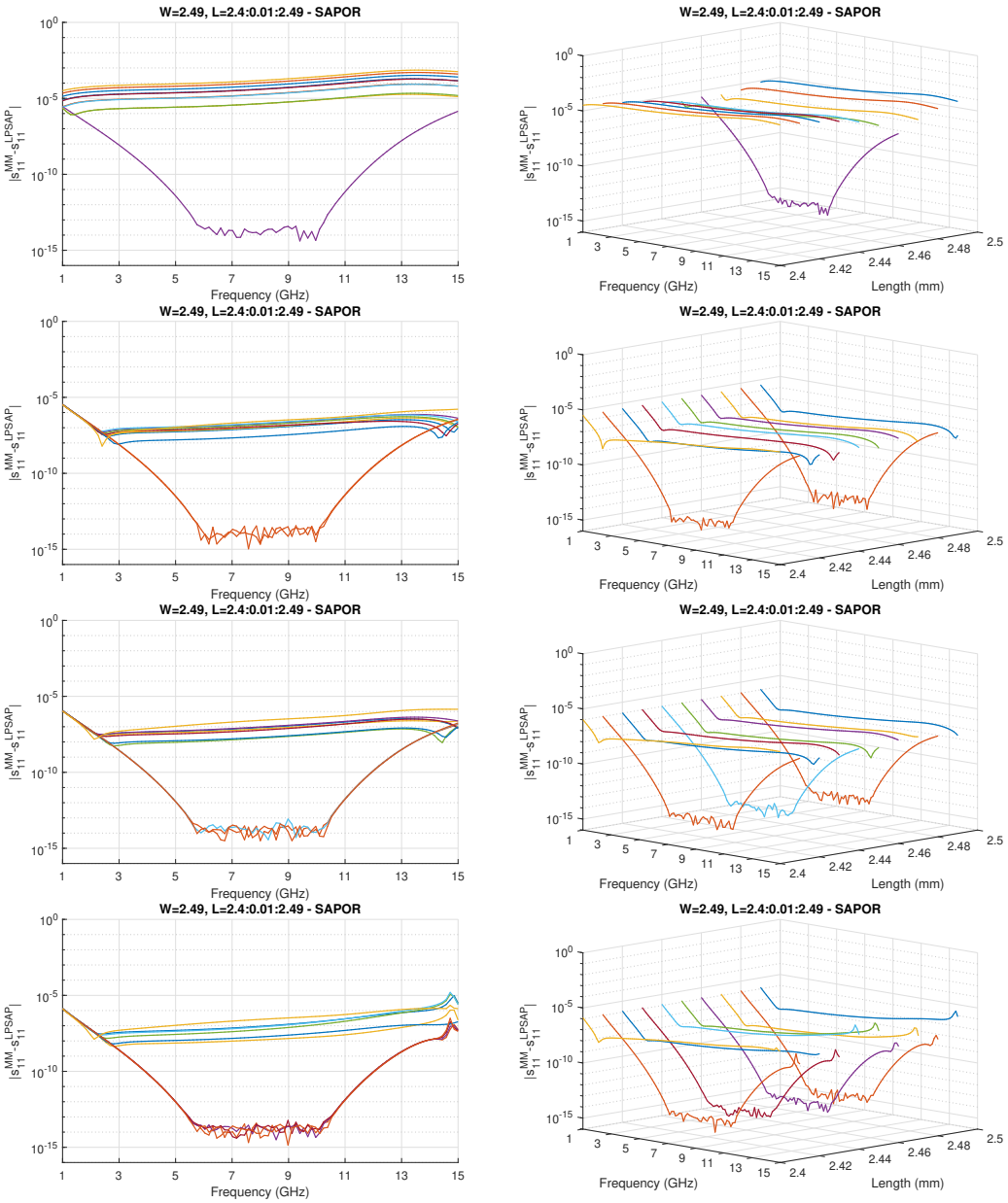

Figure 11: Actual error of s_{11} parameter for projection bases concantenated of 1/2/3/4 SAPOR bases.