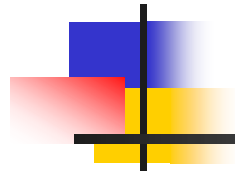


Original and accurate polynomial interpolation method to determine the surface currents with a minimum of known points in the case of diffraction and radiating problems.

J.P. Damiano, J.Y. Dauvignac
LEAT, UNSA-CNRS, Valbonne, France

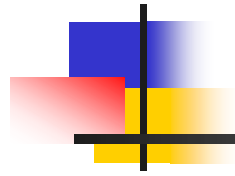
P. Dubois, C. Dedeбан, P.Y. Garel
France Télécom R&D, La Turbie, France

J.P. Zolesio
CNRS-INRIA, Valbonne, France



OUTLINE

- ✓ Introduction
- ✓ Technical modeling
 - Analysis
 - Interpolation
- ✓ Results
- ✓ Conclusion



The report

Solving electromagnetic scattering and radiation problems is time consuming.

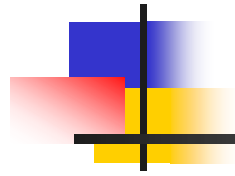
Our aim

To determine the values of the current flow over a large frequency band using a very few number of frequency samples.

Our model

To develop an accurate method based on the formal knowledge of the derivatives of the current flow.

To associate an interpolation method.



TECHNICAL MODELING > Analysis

SR3D code

- ✓ an integral equation formulation
- ✓ a variational approach
- ✓ the reaction concept of Rumsey
- ✓ a surface finite element method
- ✓ a triangular discretization

Computer algebra

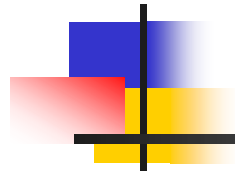
Using the Maple computer algebra to derivate the variational formulation

The matrices

X : current flow vector

$$A.X = B_0 \quad A.X' = B_1 \quad A.X'' = B_2$$

B_1, B_2 functions of $X, X', A, A', A'', B_0, B_1$



TECHNICAL MODELING > Analysis

Interpolation method

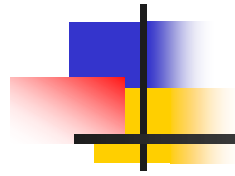
- ✓ Current flows and its derivatives known at some frequency samples.
- ✓ Choice of an interpolation method > polynomial function (degree 5).
- ✓ Critical points.

Tests

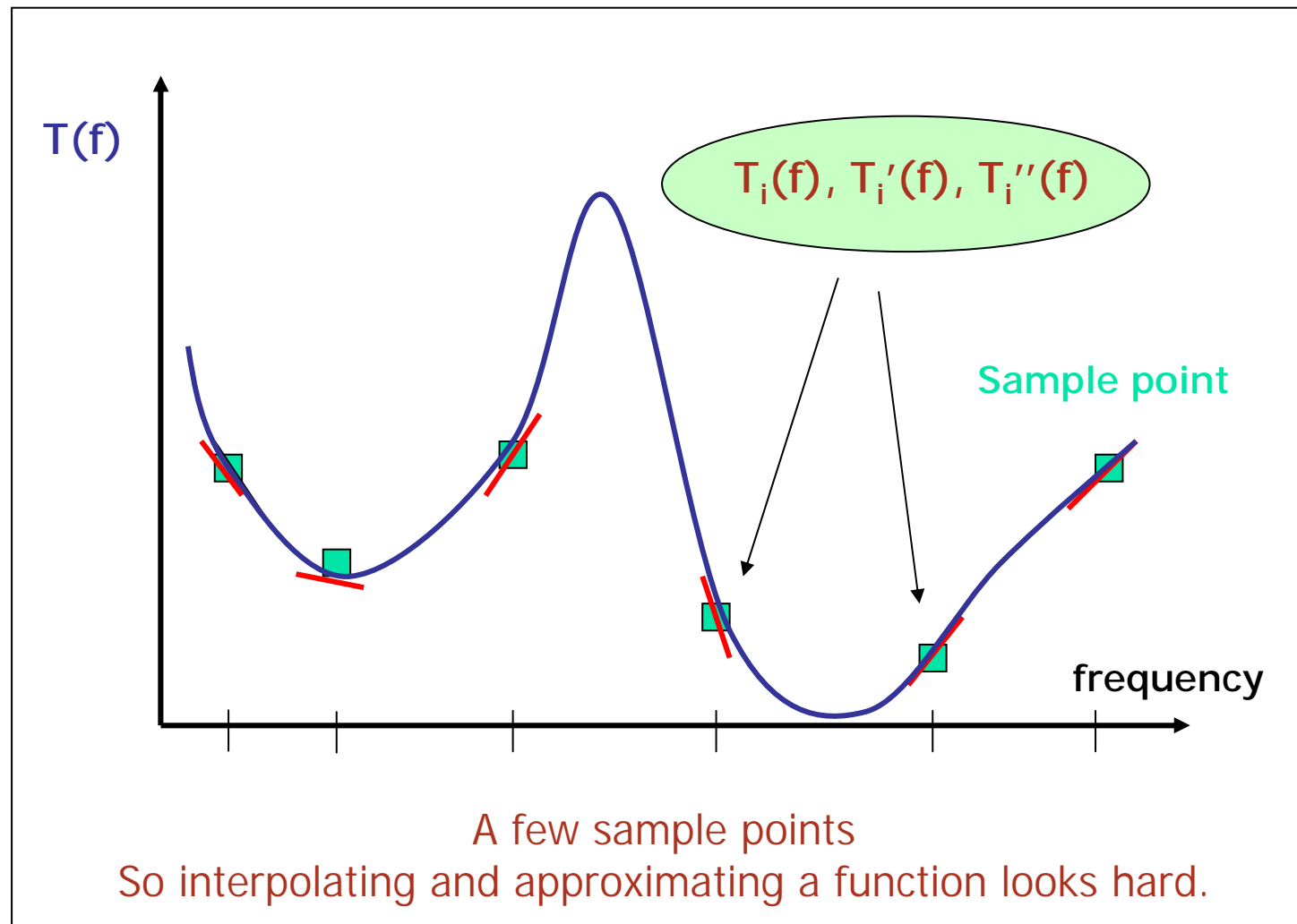
- ✓ Some test functions to choice the optimal interpolation method.
- ✓ Influence of the number of sampling points.
- ✓ Applications to various geometries.

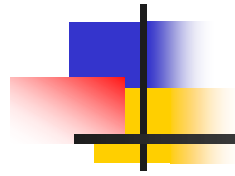


The optimized and adaptive SR3D code



TECHNICAL MODELING > Interpolation





TECHNICAL MODELING > Interpolation

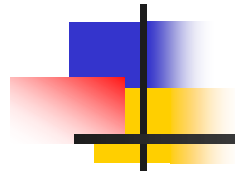
Case 1 : Only the values of the function are known

Least-square method.
Polynomial and trigonometric functions.
Taylor series and Chebyshev approximations.
Piecewise polynomial functions.
Splines, cubic splines, B-splines functions.
Rational functions.
Padé approximations.
Thiele interpolations.
and so on.

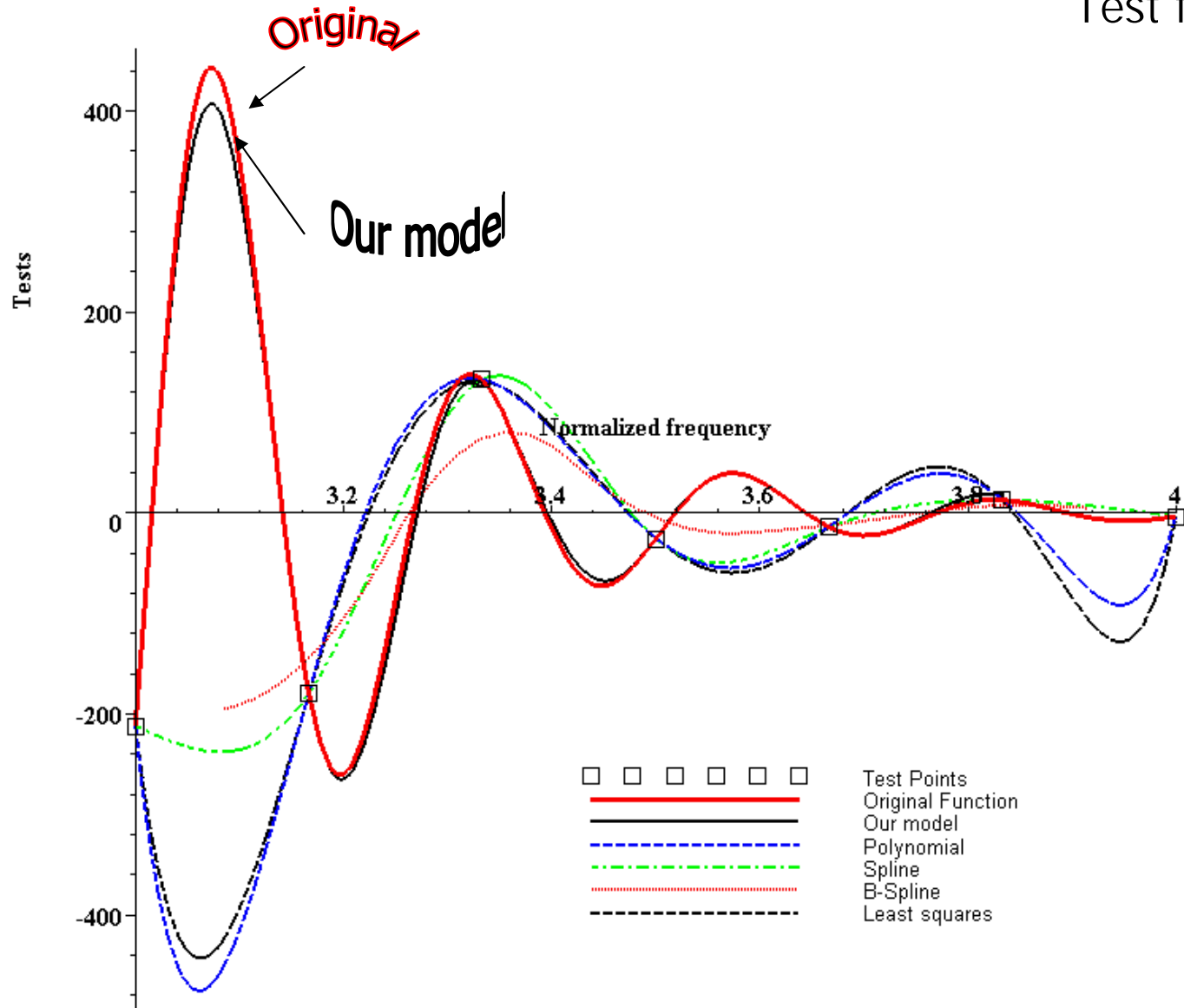
Case 2 : The values of the function and its derivatives are known

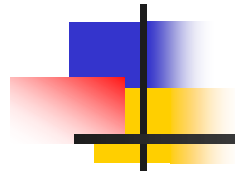
Splines, cubic splines, B-splines functions.
Piecewise polynomial functions

We compared various methods

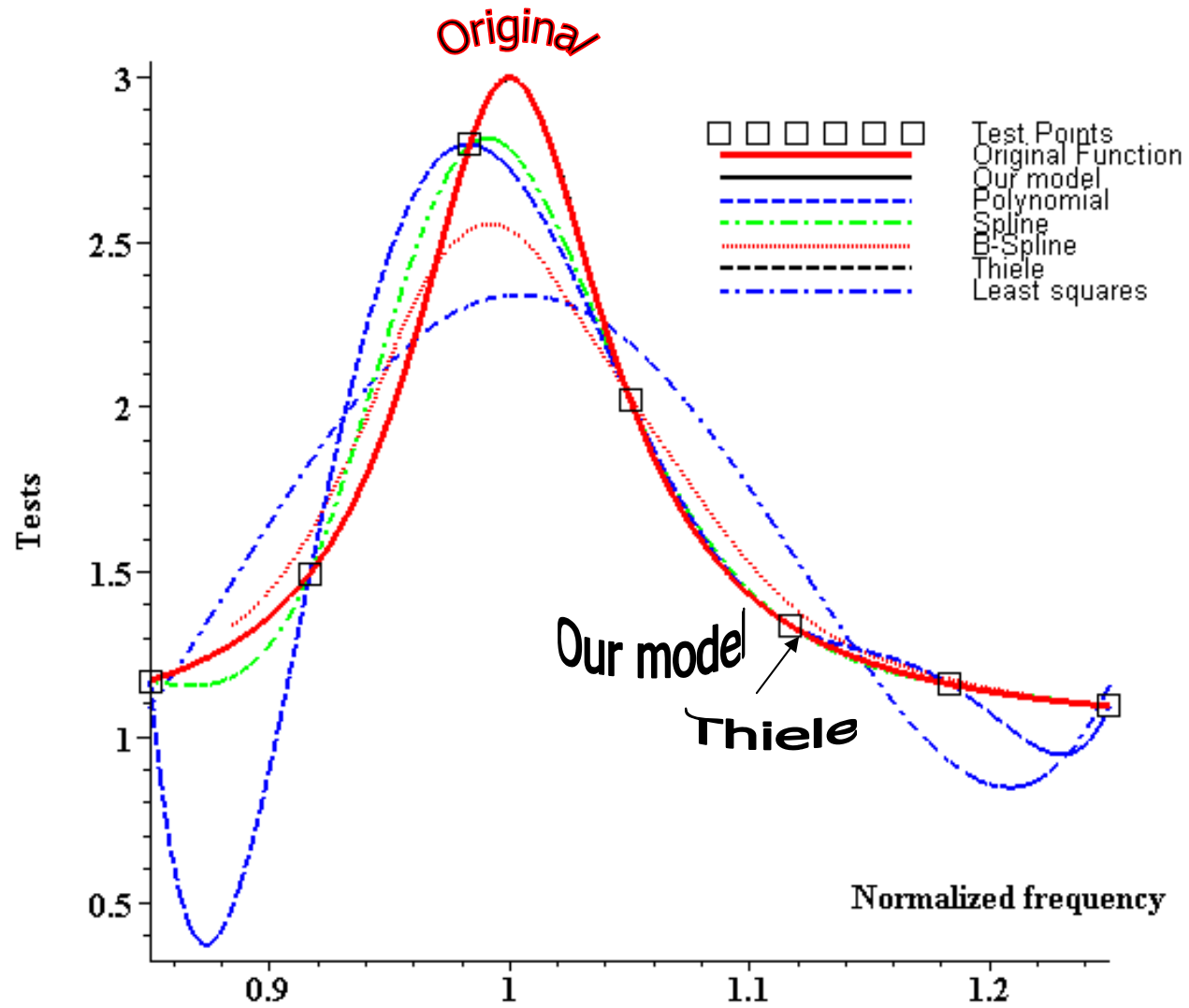


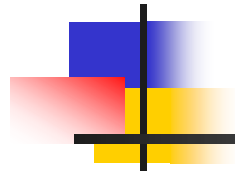
Test function 1



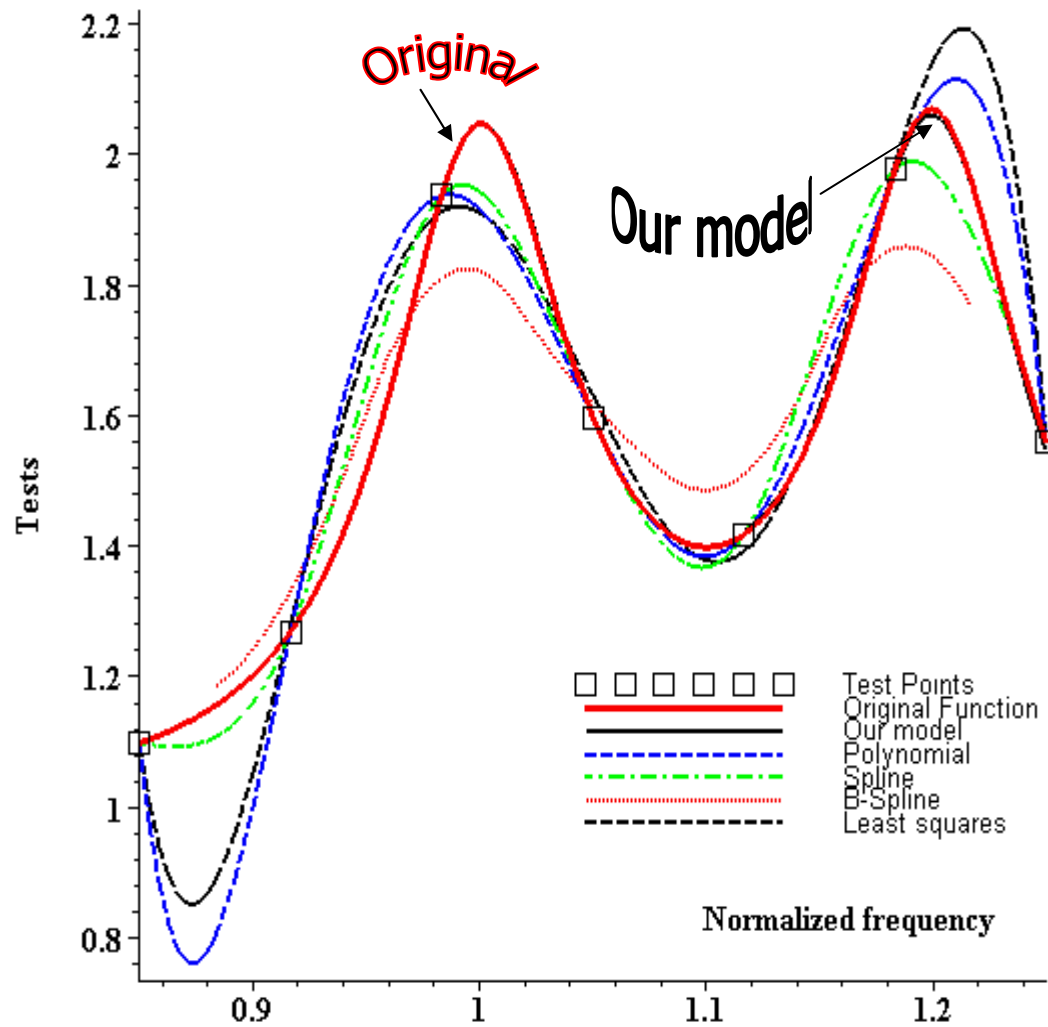


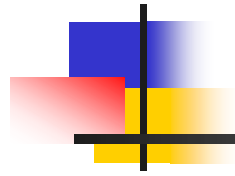
Test function 2 One peak





Test function 3 Two peaks



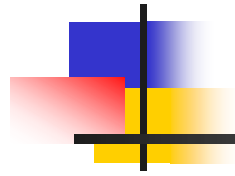


RESULTS

- ❑ A line slotted patch antenna
 - The quadratic error
 - The radiation patterns

- ❑ A circular waveguide
 - The VSWR

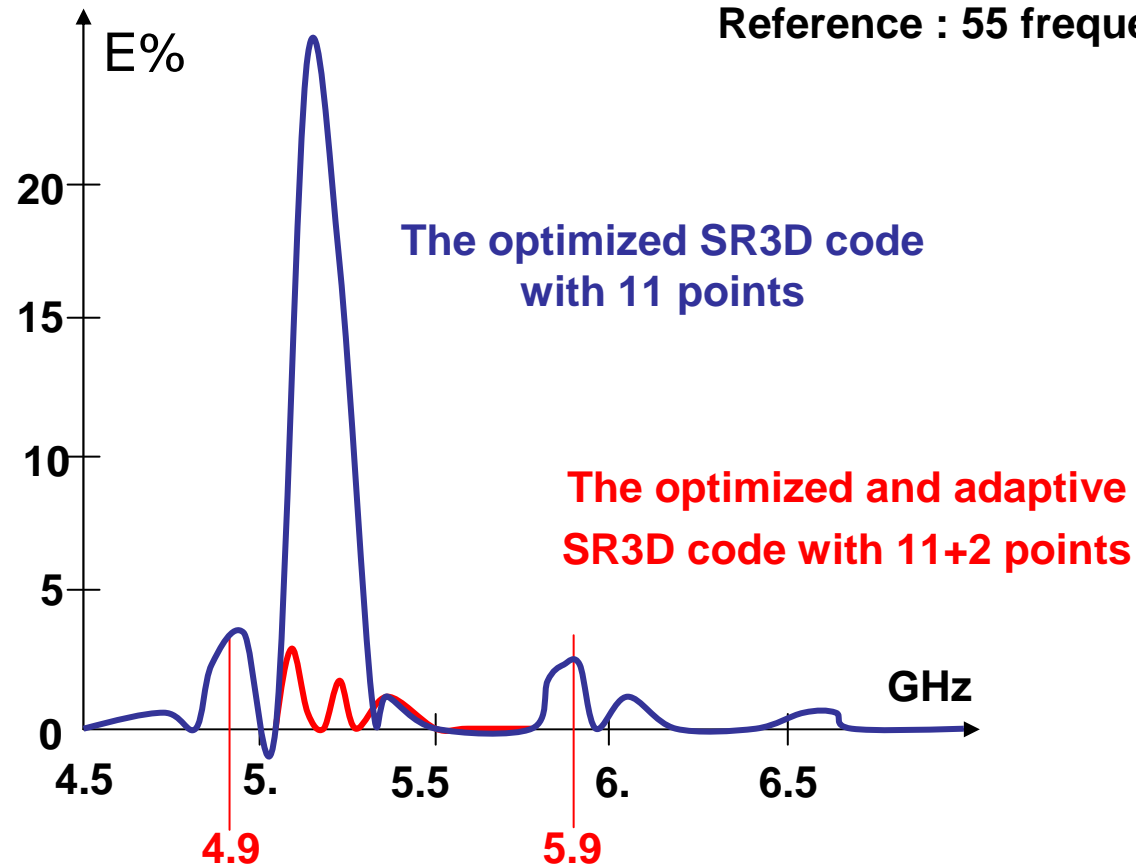
- ❑ Optimized computing time

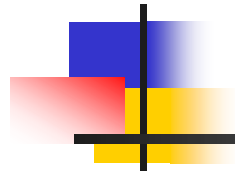


A line slotted patch antenna : 4.5 - 6.5 GHz

Variations of the quadratic error

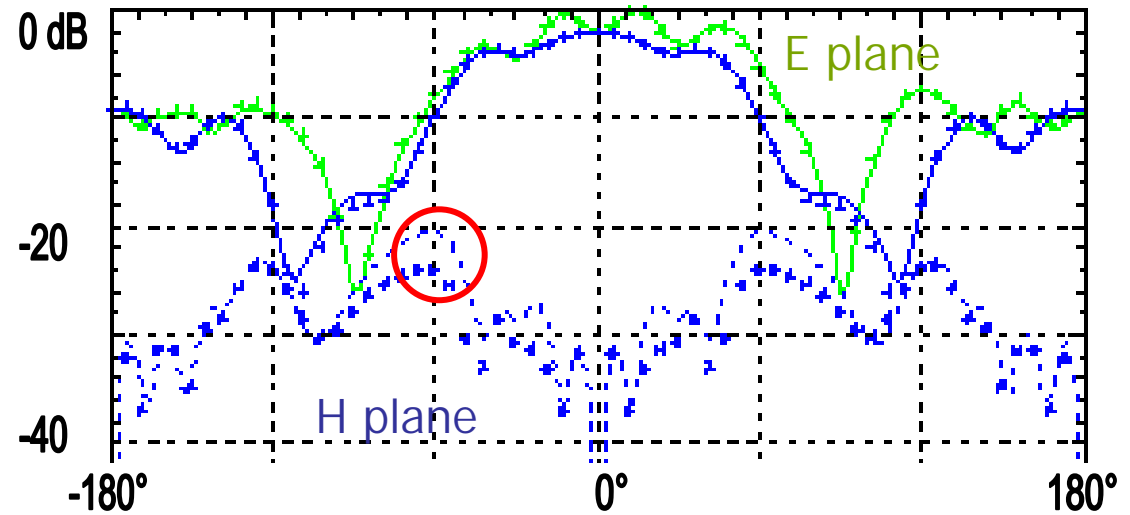
Reference : 55 frequency samples



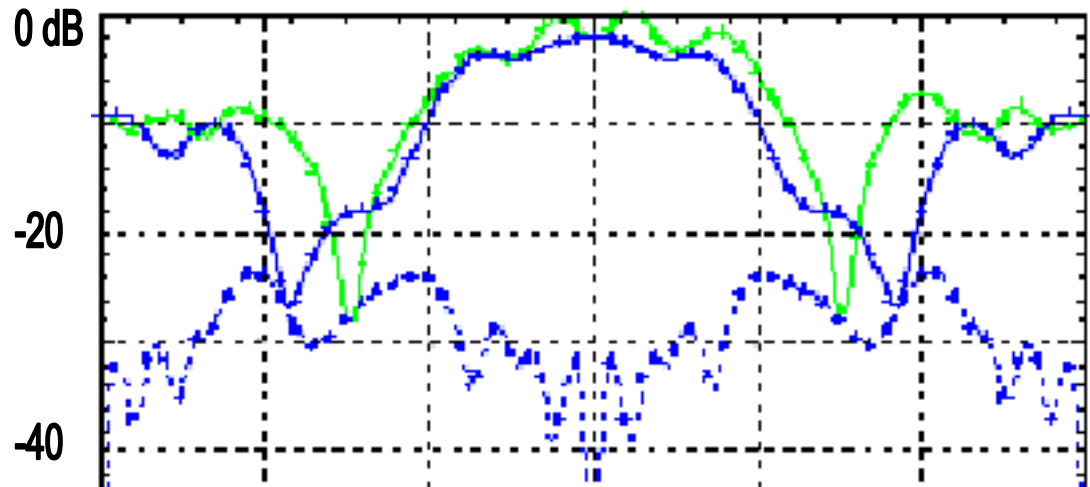


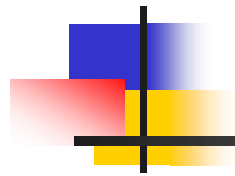
A line slotted patch antenna : 5.1 GHz

with optimized SR3D code



*with optimized and adaptive
SR3D code*

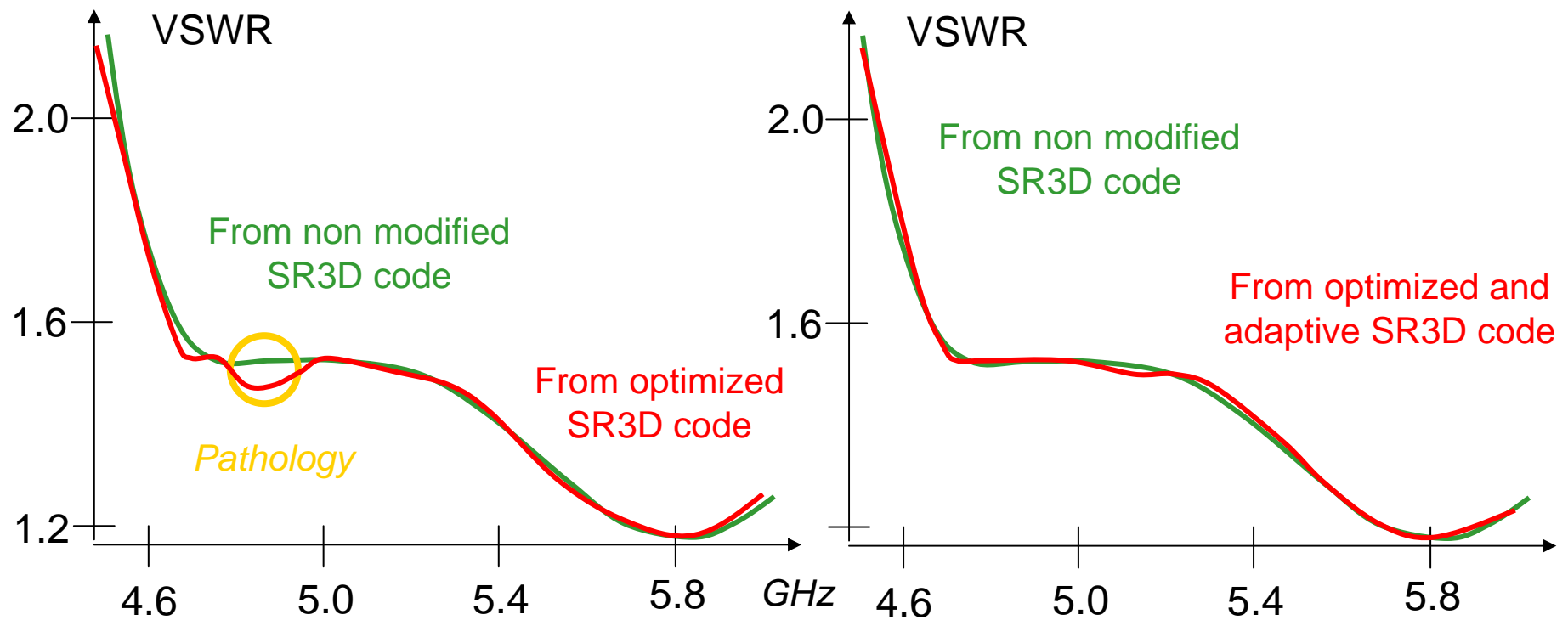


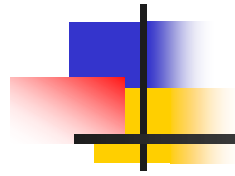


A circular waveguide : 4.5 - 6 GHz

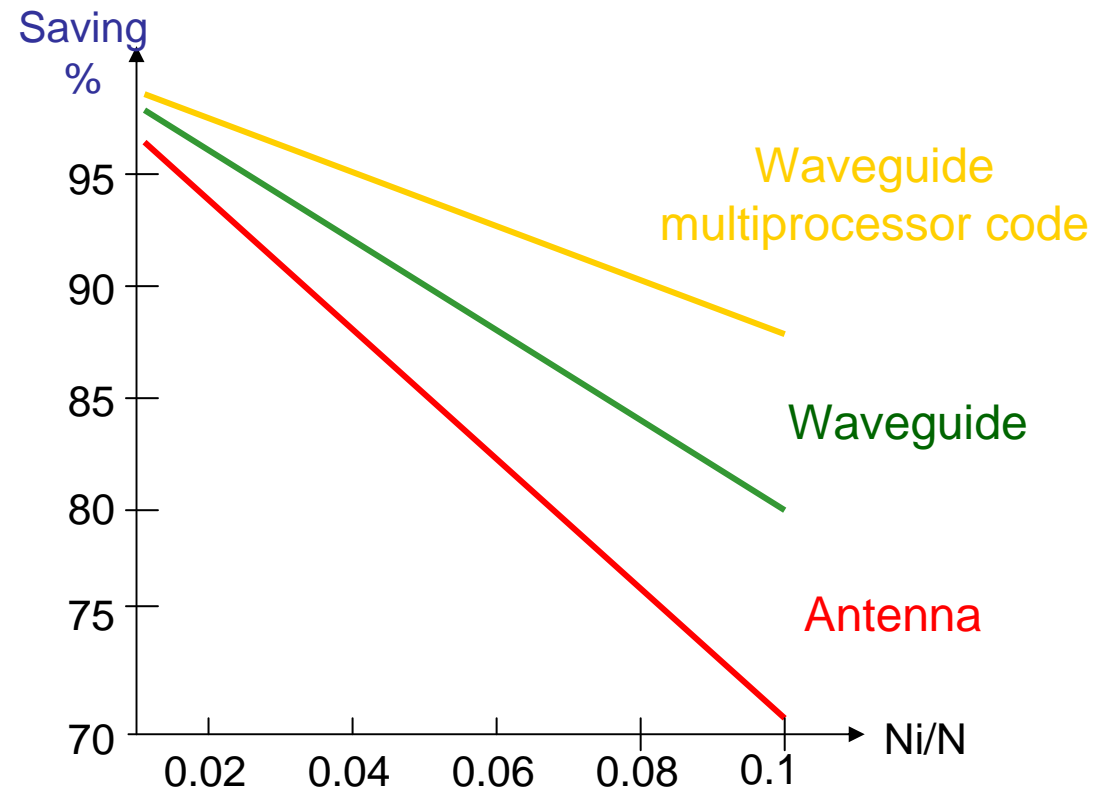
Variations of the VSWR

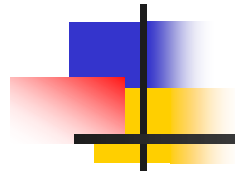
Reference SR3D : 70 points / Adaptive code : 7+1 points





Optimized computing time





CONCLUSION

- ✓ An original and accurate optimization technique.
- ✓ An efficient model based on the formal derivatives of the current flow.
- ✓ Very good and promising results.
- ✓ A true time-saving

Thank you for your attention

Grazie mille per la vostra pazienza