

# Preparing for the Future

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## ESA Honoured by Award of International Trophy for Quality



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Madrid, 21st March 1992

The President



The *Editorial Office* (that is the spelling) is an independent organisation that presents awards for quality and technological achievements.

ESA is proud that the Editorial Office, at its twentieth anniversary meeting, chose to present the Agency with the Golden Trophy of Quality 1992. The citation states that the award was made for *outstanding quality performance on space programmes*.

The ceremony took place in Madrid, Spain, and Mr. Lars Tedeman, Head of Product Assurance and Safety Department at ESTEC, accepted the trophy on behalf of the Agency. At the ceremony, he was supported by Mr. V. Claros, Station Director of the ESA establishment at Villafranca, close to Madrid.

# WIND — A User-Friendly CAD Tool for Waveguide Filters

M. Guglielmi, G. Gheri & A. Alvarez, Radio Frequency Systems Division, ESTEC

## Funding:

Basic Technology Research Programme

## Introduction

The development of fast and accurate Computer-Aided Design (CAD) tools is of key importance for the efficient manufacturing of space hardware.

This is particularly true in the case of microwave filters since, traditionally, their development requires substantial experimental work.

In this article we describe the novel software package WIND, developed at ESTEC for the analysis and design of microwave filters based on thick inductive windows in rectangular waveguides.

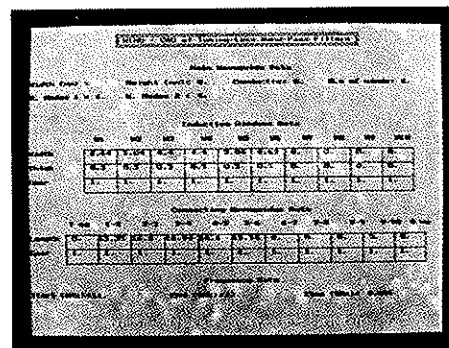
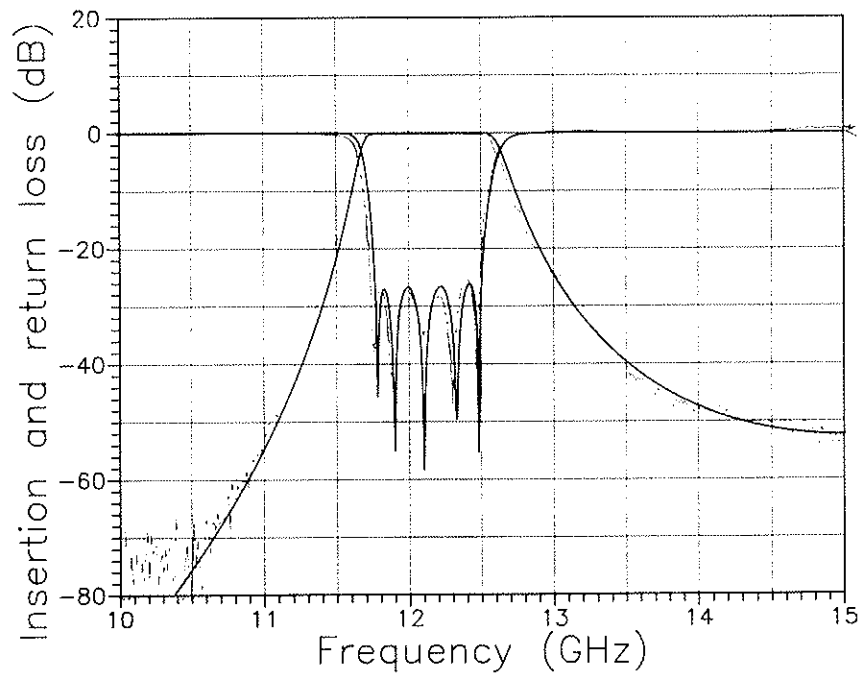
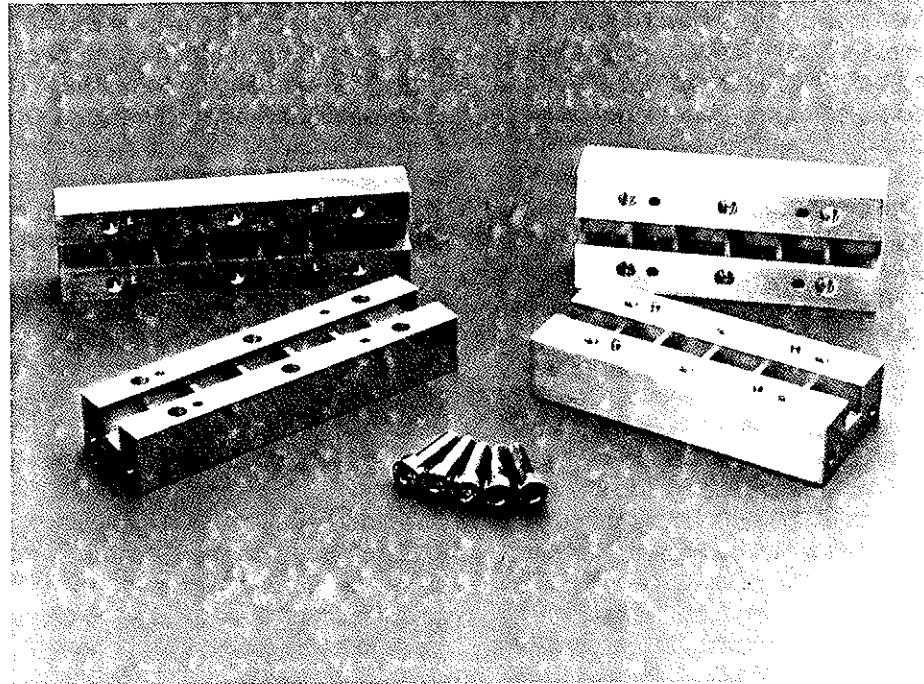
WIND is computationally very efficient and can also be used in small PCs. Its use can effectively replace all of the experimental development and manual tunings traditionally required for the development of microwave filters thus significantly reducing both development time and cost.

## The structure of WIND

The CAD package WIND performs the full-wave analysis of microwave filters based on inductive windows. It is based on a novel theoretical approach developed at ESTEC that leads to very efficient computer codes.

The main feature of the theory behind WIND is that the accurate electromagnetic characterisation of the elements of the filter is done independently from the frequency of operation and from the absolute dimensions of the geometry.

As a consequence, most of the computations that are required have to be carried out only once, the results are then stored in a data file of modest dimensions.



Top: Example of two filters without tuning elements realised using WIND

Bottom: Measured (orange) and computed (black) performance of the two filters

Left: A WIND input screen

# WIND — A User-Friendly CAD Tool for Waveguide Filters (continued)

When designing a specific filter, the necessary data are simply retrieved and not computed again. The additional frequency dependent computations, that must be performed to obtain the electrical behaviour of the complete filter, are very simple, therefore they can be carried out even on a small PC.

A comparison of computational efficiency between a program based on the theory developed by ESTEC and another software package based on mode-matching, was performed by British Aerospace Systems, Stevenage, UK. The filter analysed was a five-cavity bandpass filter and the computations were carried out for 201 frequency points. The two packages gave results of the same accuracy, but WIND performed the computations running 14 times faster than the software based on mode-matching.

The CAD package WIND developed using this theory consists of a user-friendly graphic interface that allows access to the data of the structure to be analysed. The results obtained can be displayed on the screen either in numerical or graphic form. The calculations are performed by a subroutine written in FORTRAN.

## The use of WIND

The main subroutine in FORTRAN for the computation of the electrical characteristics is the core of WIND and it can be used independently as a part of application specific CAD tools for industrial design and manufacture.

WIND, however, has been developed as a learning tool as well as a microwave filter design tool. The procedure to be followed for the design of a specific filter can be exactly the same as it would be if the filter were to be developed experimentally piece by piece, assembled and then manually tuned in the laboratory. The difference is that all of the necessary measurements are replaced by

computer simulations and the final manual tuning is performed by the user, directly changing the critical dimensions of the filter, until a satisfactory result is obtained.

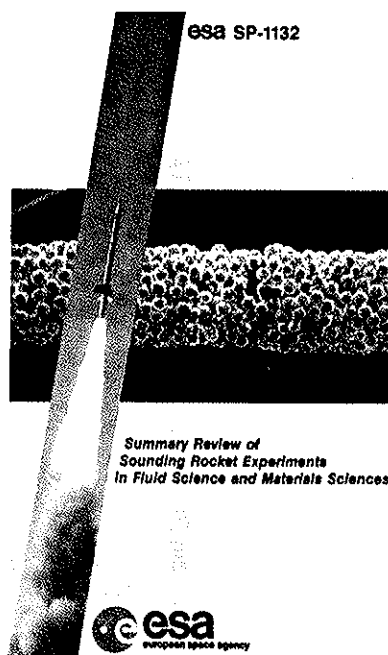
This particular implementation was chosen to provide hands-on experience for the design of microwave filters to young engineers that come to ESTEC under the various training programmes of the Agency. For industrial use, a more advanced design procedure has been developed (ESA/PAT/271).

## Conclusion

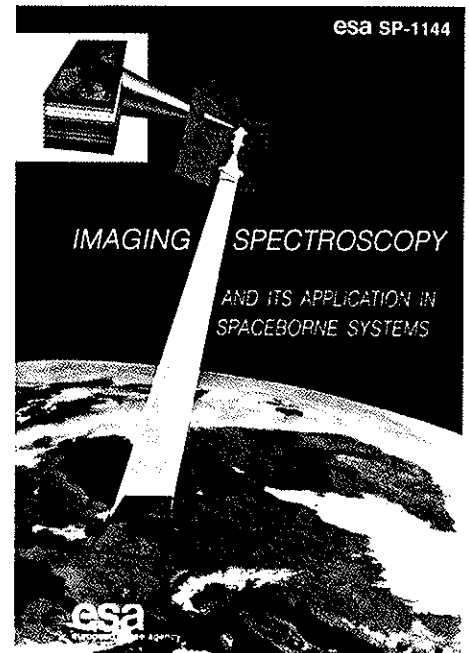
WIND is very user-friendly and extremely efficient from a computational point of view. Its use can effectively replace all of the experimental work traditionally required for the development of these types of filter.

This software package is expected to be of real value to European industries involved in the manufacture of this type of hardware.

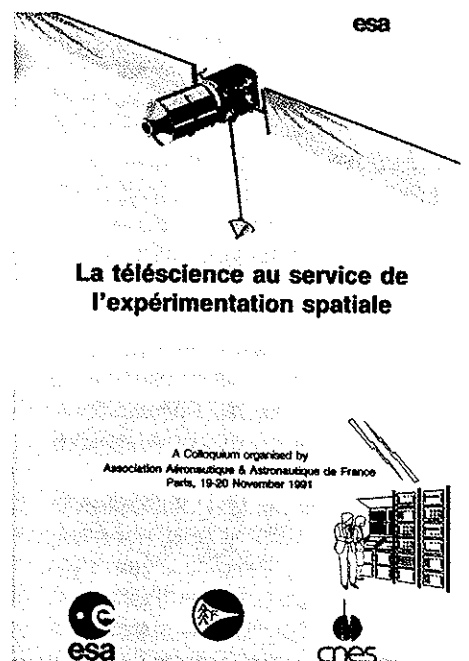
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