

## Success Story

# SW Filter Design Optimization Expertise Integrates into NI AWR Software for Faster, More Accurate Filter Designs

## Company Profile

SW Filter Design offers sophisticated microwave filter design software that produces accurate dimensions ready for manufacturing. The company also provides powerful optimization engines that are tailored to the filter design process, as well as software that will automatically build filter models ready for EM simulation.

## The Design Challenge

General purpose optimizers are typically not very robust for optimizing higher order microwave filters as they often fail to control the passband exactly and leave one or more resonators mistuned. SW Filter Design offers high end optimization expertise and wanted to integrate that expertise into a complete RF/microwave design environment such that designers would have access to the most sophisticated filter design and optimization tools on the market.

## The Solution

SW Filter Design chose to integrate its Equal Ripple Optimization software within Microwave Office circuit design software. The resulting EQR\_OPT\_MWO solution (Figure 1) is a dedicated optimizer for microwave bandpass filters that leverages NI AWR Design Environment™ COM Automation API and can optimize any filter that can be defined in Microwave Office. For example, lumped element filters, planar microstrip filters or waveguide filters can be optimized using the Microwave Office element catalog. In addition, S-parameter files imported from any planar or 3D EM simulator can be port tuned.

SW  Filter Design

Application:  
Filter Design and Optimization  
Software:  
NI AWR Design Environment  
Microwave Office



“The NI AWR Design Environment COM API and scripting have given us a unique opportunity to integrate our optimization expertise into a modern, full-featured design environment. The resulting filter design flows are quite intuitive and easy to apply.”

– Dan Swanson  
Partner

SW Filter Design  
swfilterdesign.com

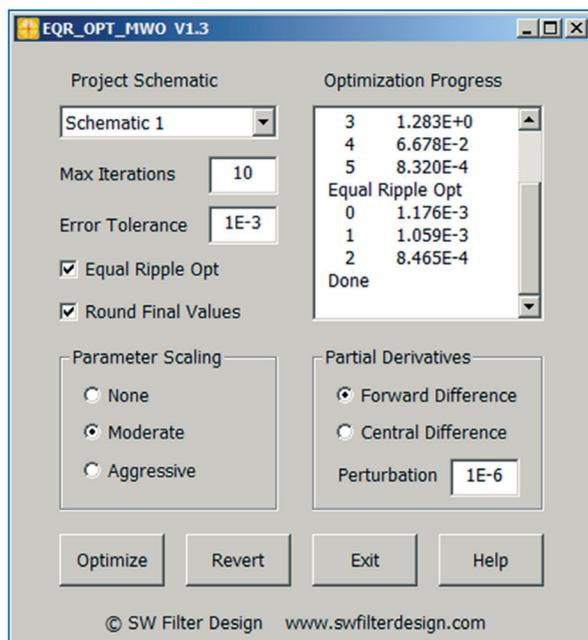


Figure 1: EQR\_OPT\_MWO is a standalone compiled program that allows users to select any schematic from within NI AWR software.

Unlike many general purpose optimizers, EQR\_OPT\_MWO finds an exact equal ripple response. General purpose optimizers often fail to find all the reflection zeros in the passband, particularly for higher order filters. Because EQR\_OPT\_MWO returns a perfect equal ripple response after each optimization (Figure 2), the tunings extracted from the circuit simulation are accurate and consistent. SW Filter Design engineers were able to bring the filter back to perfect equal ripple tuning in only 10 iterations of their optimizer. Total optimization time was about four seconds compared to a general purpose optimizer, which can run for hundreds of iterations and not find the desired final response.

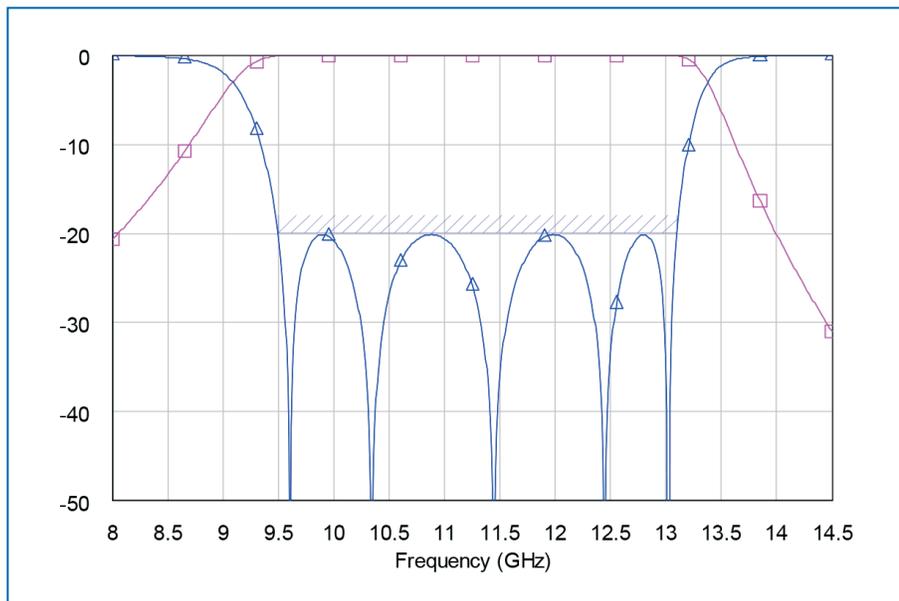


Figure 2: Output of optimized design.

## Why NI AWR Design Environment

SW Filter Design has been using this optimization engine for many years, often inside homegrown simulators and design programs. The problem is that there is limited access to circuit models and no resources to create them in house. Writing custom circuit simulators is also a quite daunting task. Using the COM API and scripting in Microwave Office, SW Filter Design was able to add its optimization expertise to the NI AWR Design Environment. The advantage this gives the company is quite remarkable. The software engineers can now focus on what they know best and take advantage of the deep feature set of Microwave Office, all at the same time. The word “synergy” is often overused, but it clearly applies here. The simulation speed and ease of use first drew them to NI AWR Design Environment—then they discovered the well-documented COM API.

Dan Swanson, partner at SW Filter Design, commented that he thinks many people would be surprised how much they rely on optimization and how little synthesis is used in the company’s filter designs. Because the optimization process is so fast and robust, new designs can be created or old designs modified quite rapidly. They have developed design flows for complex planar filters as well as high performance cavity filters and diplexers.

SW Filter Design engineers have tried to port their optimizer to other design environments but have found that Microwave Office is much faster than other simulators. They have also found that the COM API is more complete and easier to use than what is offered in other simulators. Swanson believes both are due to the strong object oriented foundation of NI AWR Design Environment.