DIY ACOUSTIC DIFFUSER DESIGNS

Performance Coefficients for Optimized Stepped Diffuser A1-LF

(The Leanfuser™)

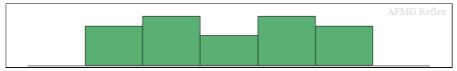
ARQEN SONIC
A DIVISION OF WESTRIVER INDUSTRIAL INC.
2012-2013
Prepared by: Tim Perry

Stepped Diffuser Designs in Chapter 7.3 of "The Lean Optimization of Acoustic Diffusers" by Tim Perry are licensed under a Creative Commons Attribution-NonCommercial 3.0 Unported License. Consult RPG Diffusor Systems Inc. for restrictions on fractal diffusers. Background research draws from the works of Trevor Cox, University of Salford; Peter D'Antonio, RPG Diffusor Systems Inc.

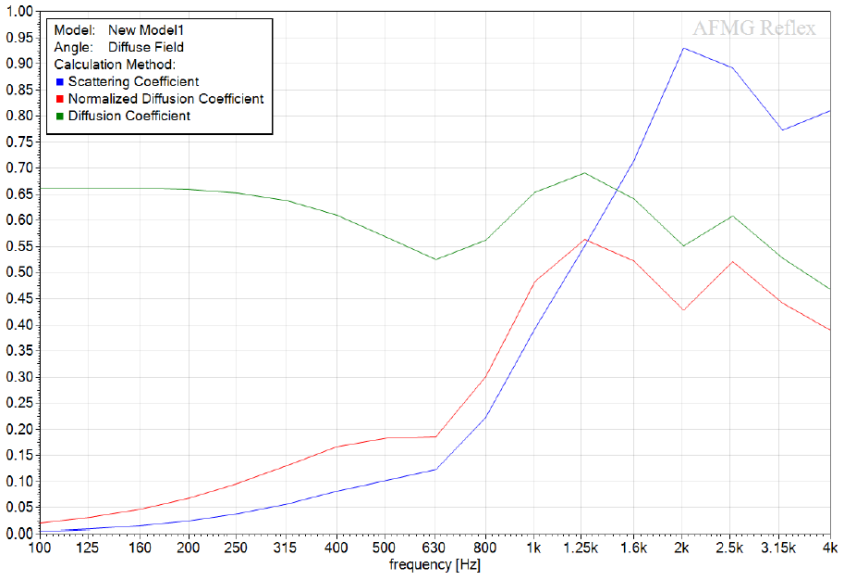
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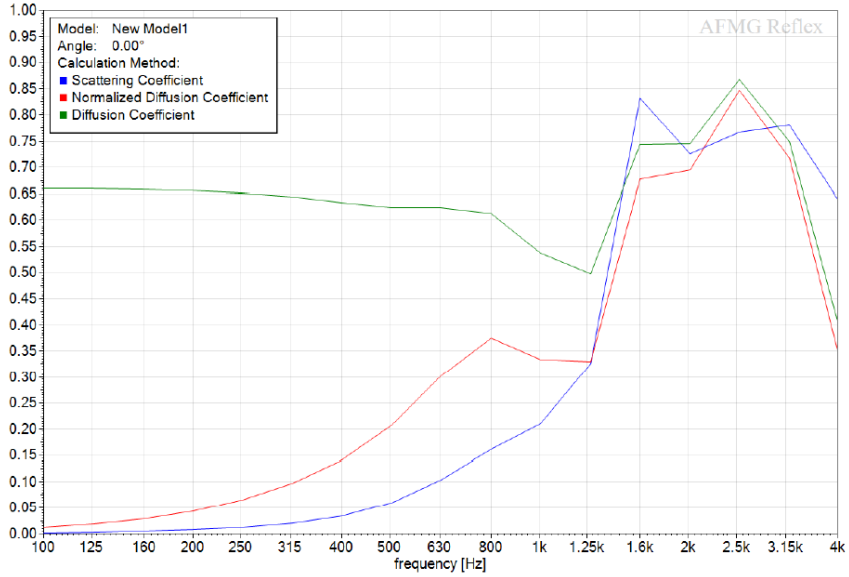
Performance Coefficients for Single Module

Depth Profile of Diffuser Module (Simulation View in AFMG Reflex)



Performance Coefficients for Diffuser Module





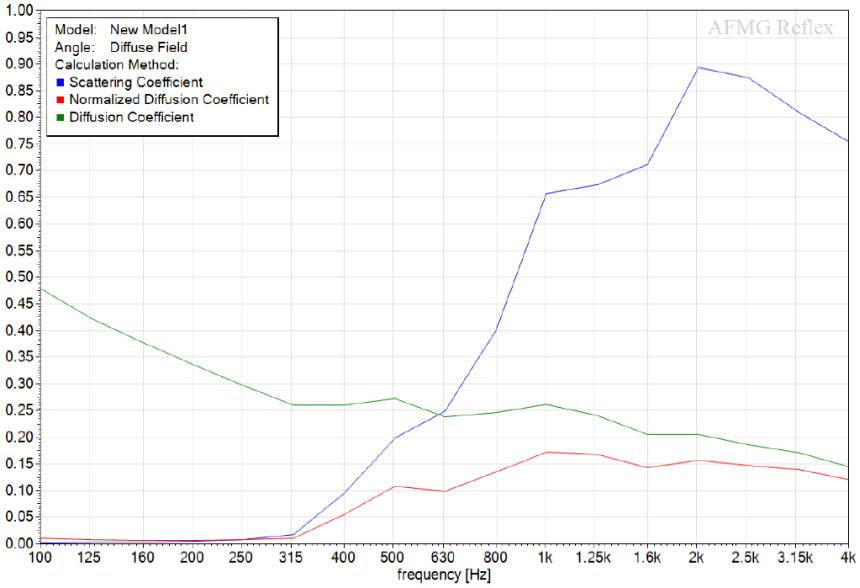
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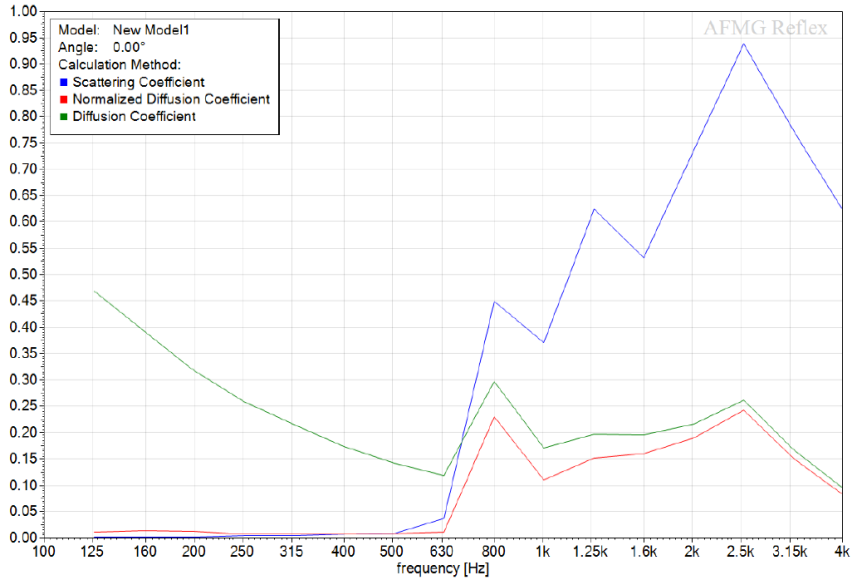
Performance Coefficients for Periodic Array of 5 Modules

Depth Profile of Diffuser Array with No Profiled Modulation 1 (Simulation View in AFMG Reflex)



Performance Coefficients for Periodic Array of 5 Modules



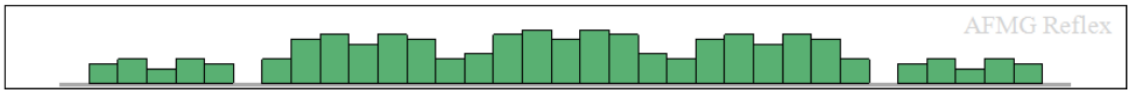


Profiled Modulation 1: Mounting 5 Modules to Prevent Periodicity

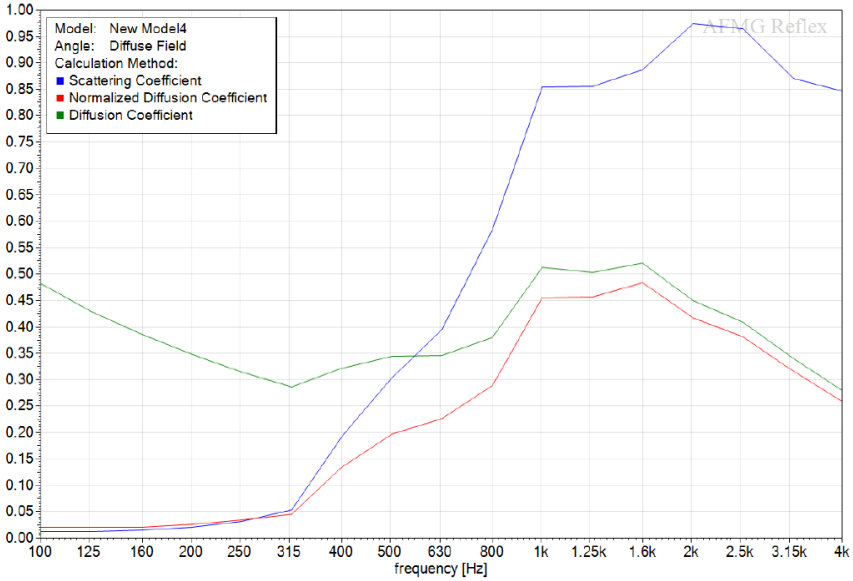
To reduce the effects of periodicity in the array, mount 5 modules with varying depths as follows:

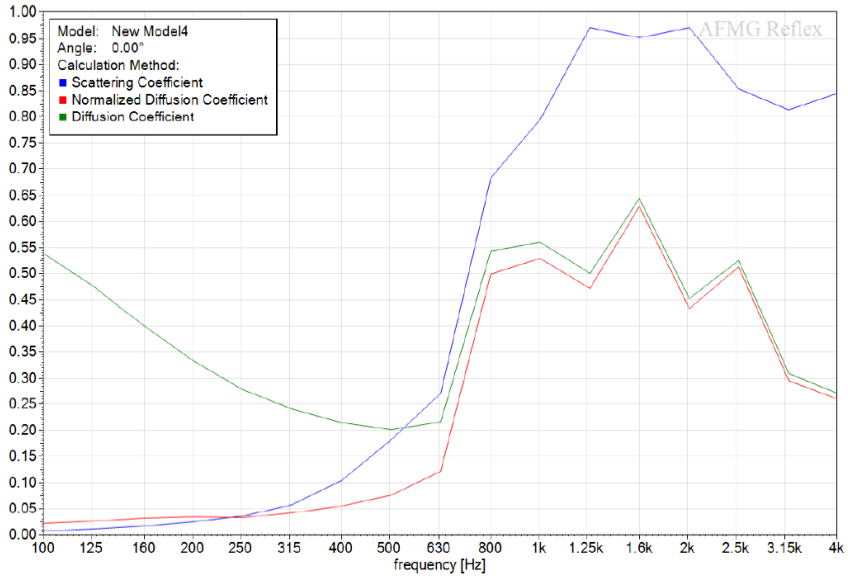
[0 cm, 5 cm, 6 cm, 5 cm, 0 cm]

Depth Profile of Diffuser Array with Profiled Modulation 1 (Simulation View in AFMG Reflex)



Performance Coefficients for Profiled Modulation 1





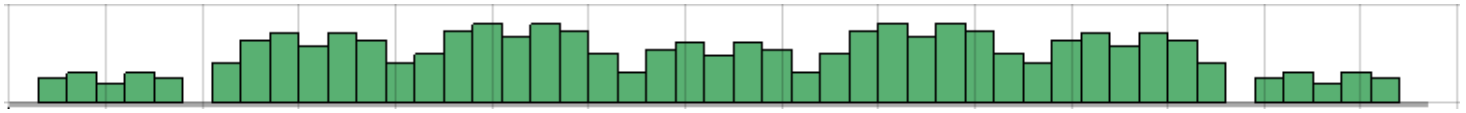
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Profiled Modulation 2: Mounting 7 Modules to Prevent Periodicity (*Fractal Modulation*)

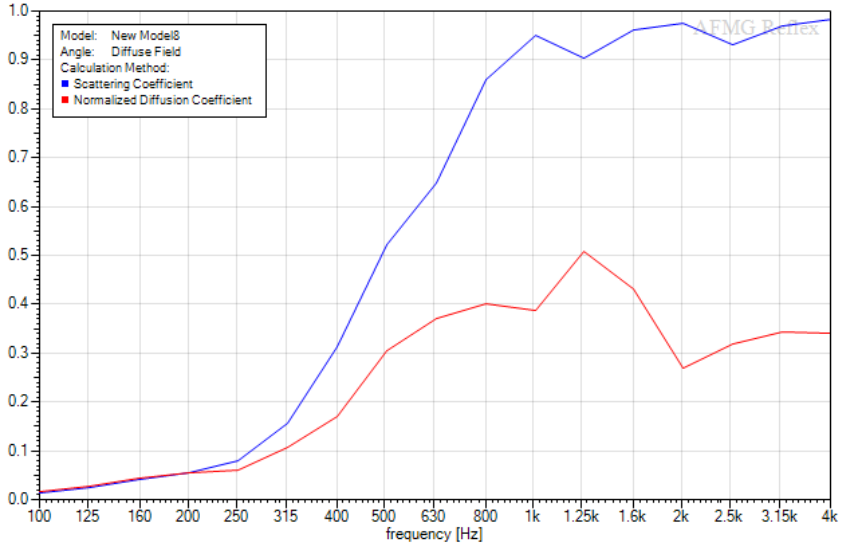
To reduce the effects of periodicity in the array, mount 7 modules with varying depths as follows:

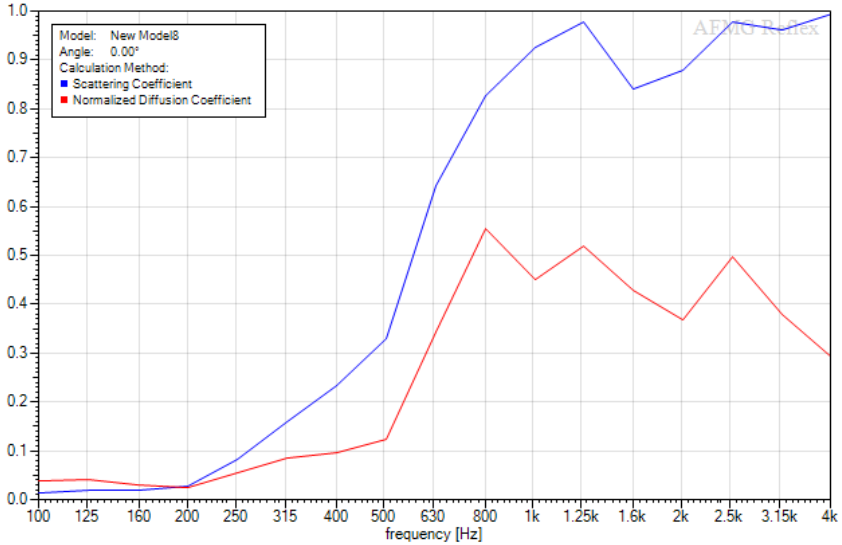
[0 cm, 8 cm, 10 cm, 6 cm, 10 cm, 8 cm, 0 cm]

Depth Profile of Diffuser Array with Profiled Modulation 2 (Simulation View in AFMG Reflex)



Performance Coefficients for Profiled Modulation 2





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More about Fractal Modulations

Profiled Modulation 2

Profiled Modulation 2 uses seven A1-LF (Leanfuser™) modules mounted at different depths based on fractal self-symmetry. The seven mounting depths are derived from the depth sequence of the Leanfuser™. The resulting diffuser has basic fractal geometry; therefore, you can call this a *fractal modulation*. And if you applied this modulation to A1-frac (the fractal version of the A1-LF module, which is detailed in Chapter 8 of the diffuser design thesis), you'd have a 3rd order nested fractal!

The mounting sequence [0, 8, 10, 6, 10, 8, 0] cm is based on the depth sequence of the Leanfuser™ multiplied by 2:

$$2x[0, 4, 5, 3, 5, 4, 0] \text{ cm} = [0, 8, 10, 6, 10, 8, 0] \text{ cm}$$

I chose the scaling factor of 2 because it creates a shallow profiled diffuser that offers good performance with minimal depth. The scaling factor was determined experimentally by simulating various profiled modulations using AMFG Reflex.

Feel free to test the performance of your own fractal design variations by choosing a scaling factor, applying it to the Leanfuser™ depth sequence, and simulating the resulting modulation using AMFG reflex. If you find a design that performs well that you want to share, please email me (tim@arqen.com), or better yet, share it with the community in the DIY diffusers forum thread.

Deep Fractal Modulation

If you don't mind a thick diffuser, you could take the fractal self-symmetry concept more literally. For example, you could create a low frequency fractal stage with the proportions equal to the stepped diffuser proportions (I.e., keeping the same width:depth ratio). For the Leanfuser™, the width:depth ratio = 42 cm / 5 cm = 8.4. Therefore, for an array of 7 diffuser modules (294 cm wide), the deepest step of the profiled modulation would be 294 cm / 8.4 = 35 cm. Since the deepest step of the Leanfuser™ is 5 cm, you would scale all the depths by 35 cm / 5 cm = 7.

This would give you a profiled modulation of 7x[0, 4, 5, 3, 5, 4, 0] cm = [0, 28, 35, 21, 35, 28, 0] cm. The resulting diffuser would have an operational depth of 40 cm, which is a much deeper design than the one we started with!