A Suggested Method to be Used to Measure the Scattering Coefficient of Full Scale Samples

Introduction

The scattering coefficient was introduced as a new concept in Part 1 of ISO 17497. Together with the absorption coefficient, the scattering coefficient is useful in room acoustic calculations, simulations and prediction models. For some time it has been known that the modeling of the scattering from surfaces is very important for obtaining reliable predictions of room acoustics. This part of ISO 17497 presented a measurement method to quantify the scattering properties of a surface to replace formerly applied but not generally accepted estimation methods.

Introduction (cont)

This method was developed based on papers presented by Vorlander, Mommertz and D'Antonio and represented the "best practices" at that time based on experiments performed on scale model "scattering" devices.

This presentation represents about 4 years of worked performed while trying to implement ISO-17497-1 at NWAA Labs using full scale samples. The scaling up of the sample size has presented a unique set of problems and answers while attempting to follow the standard to the letter, as much as possible.

Topics of Discussion

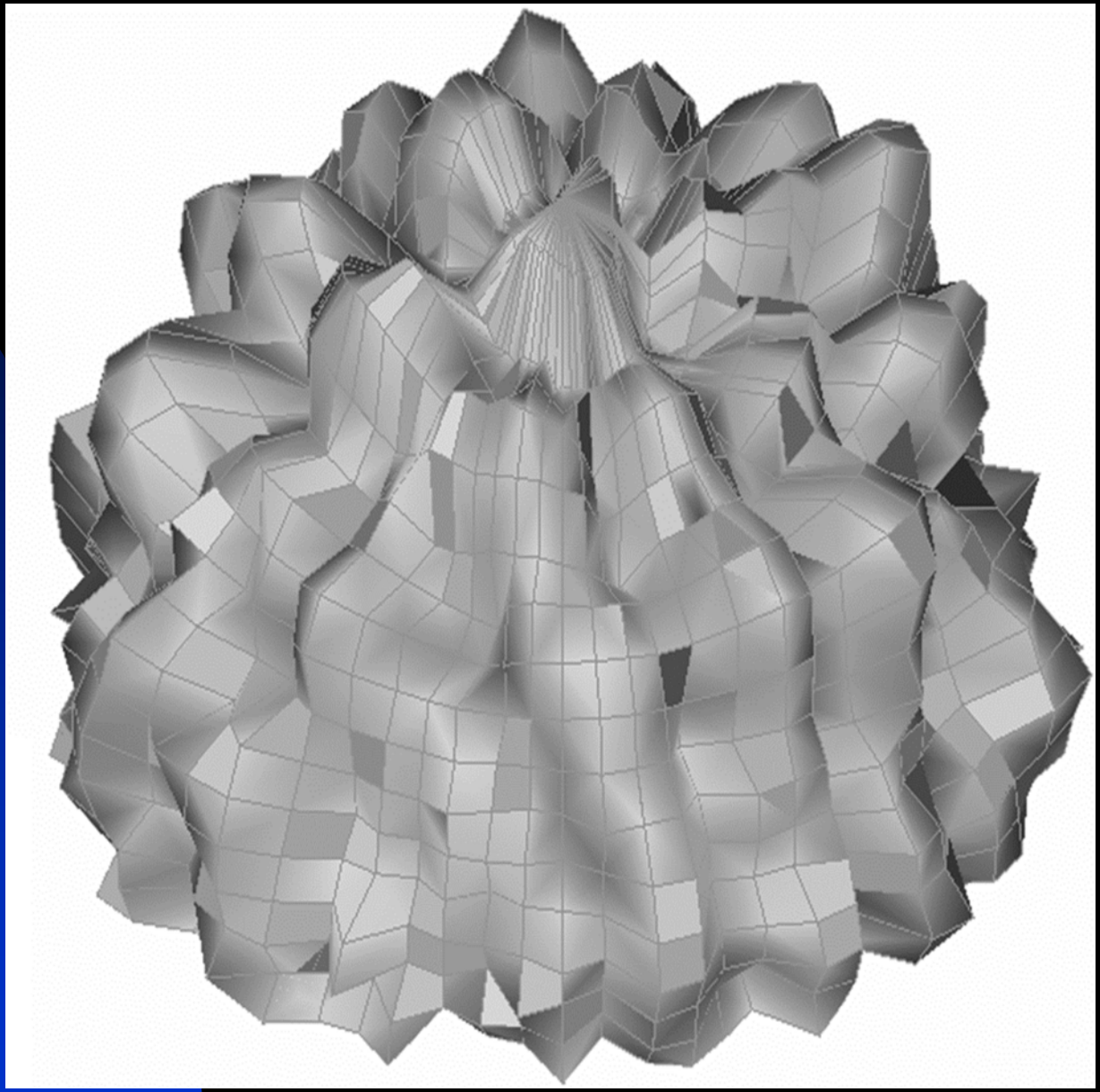
- **We will discuss the recommended methods of measuring scattering coefficients suggested in ISO-17497-1.**
- **We will also discuss the problems associated with implementing this ISO Standard using full scale samples.**
- **We will finally discuss methods we have developed to overcome these problems and to complete these measurements with full scale samples.**

Clarification of Terms: Diffusion

- **Energy:**
  - **Specular**
  - **Diffracted**
- **Geometry:**
  - **2D or 3D**
  - **Roughness or Geometric**
- **Size:**
  - **Finite**
  - **Panels**

Clarification of Terms: Diffusion (cont)

- **Measure of Quality not Quantity**
- **NOT used in Computer Modeling Programs (at this time)**



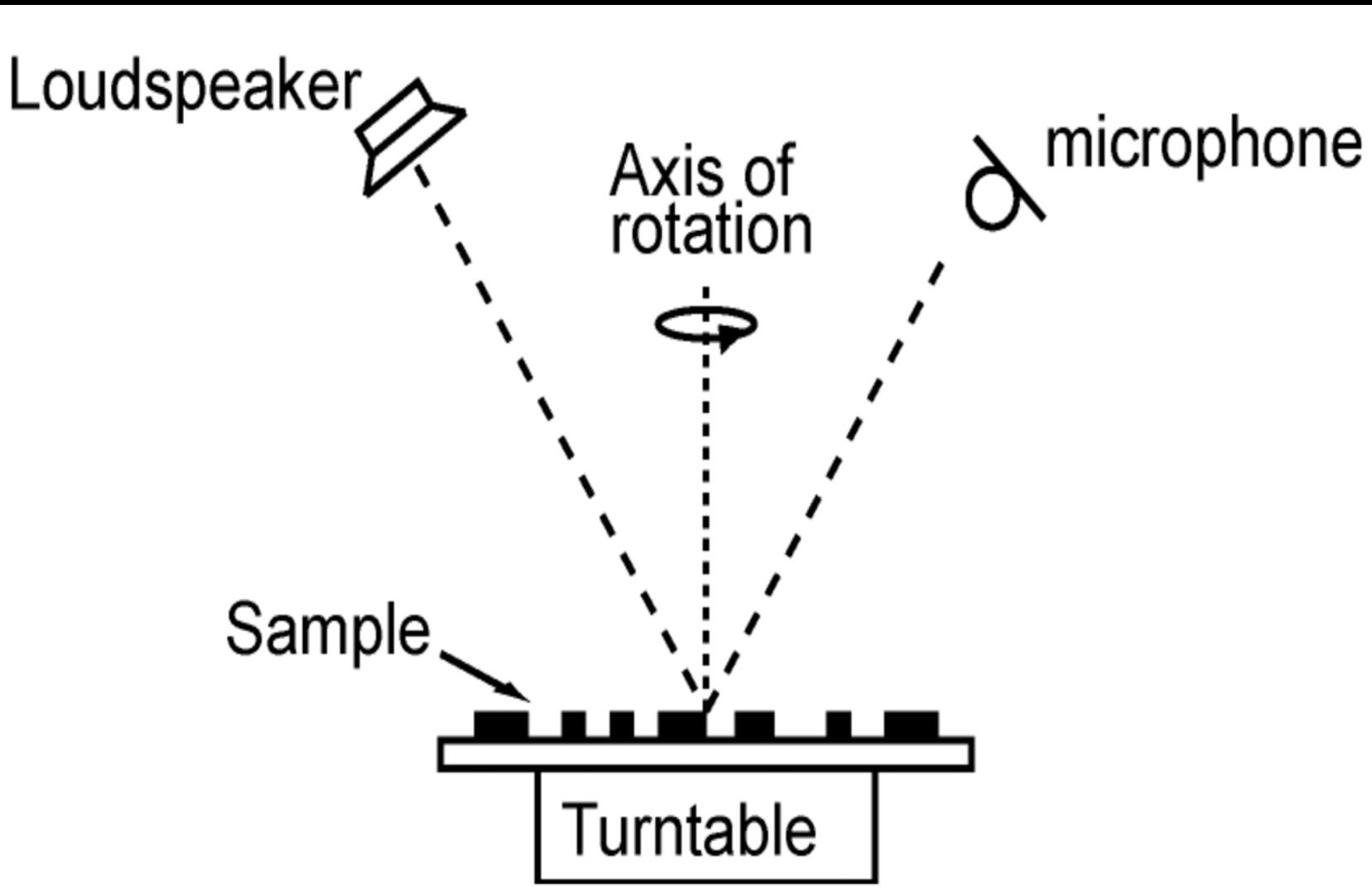
Proposed 17497-2 Result: Diffusion Balloon by D’Antonio

Clarification of Terms: Scattering

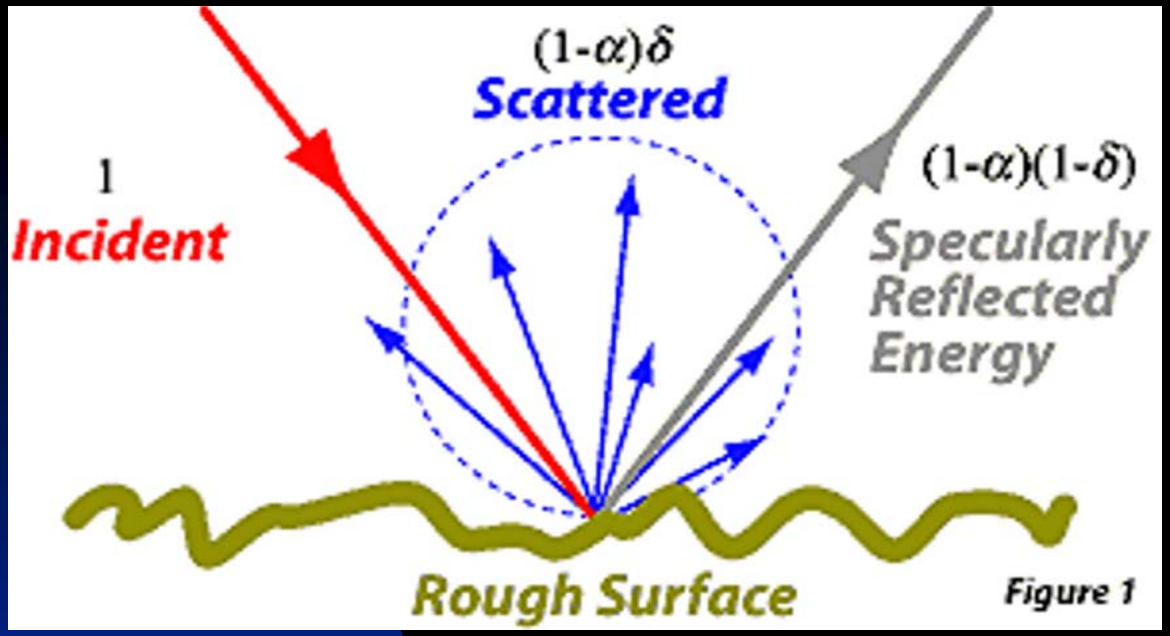
- **Energy:**
  - **Specular**
  - **Diffracted**
- **Geometry:**
  - **2D or 3D**
  - **Roughness or Geometric**
  - **Size Limitations of Topology**
- **Size:**
  - **Finite**
  - **Panels**

Clarification of Terms: Scattering (cont)

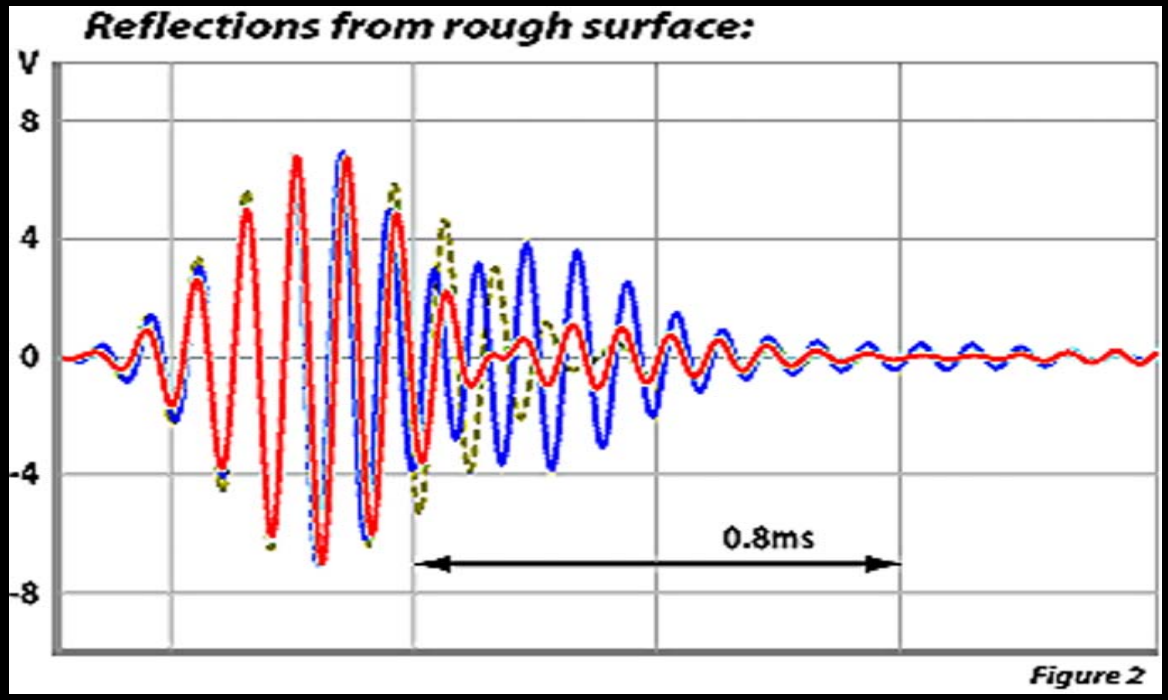
- **Measure of Quantity not Quality**
- **Used in Computer Modeling Programs like Absorption Coefficient**



ISO-17497-1 Vorlander, Mommertz



ISO-17497-1, Vorlander, Mommertz



Size Requirements (ISO-17497-1)

- **In ISO-17497-1 the sample is described as being circular (as a preference) or square and imbedded in the surface of the turntable.**
- **The size is recommended to be a minimum of 3 meters in diameter.**
- **Should not be any closer to any side wall than 1m at any point except to the floor.**

Size Recommendations for (ISO-17497-1)

- **In ISO-17497-1 the sample should be described as being circular.**
- **The size that is recommended should be a minimum of 3.5 meters in diameter.**

Method Requirements (ISO-17497-1)

- **In ISO-17497-1 the sample can be rotated or stepped thru 360 degrees during the measurement process.**
- **The stimulus recommended to be a time invariant process such as MLS to develop impulse response data.**
- **The number of samples (measurements) is to be a minimum of 6 and then to be averaged together using a “phase- locked” process.**

Method Recommendations (ISO-17497-2)

- **In ISO-17497-1 the sample should be continuously rotated thru 360 degrees multiple times during the measurement process at a very slow speed.**
- **The stimulus recommended should be a stimulus such as a log sweep, or pink noise, used to develop impulse response data. These methods are less likely to be affected by motion and environmental changes.**
- **The number of samples (measurements) is to be a minimum of 12 and then to be averaged together using a “phase- locked” process**
- **The sources should be multiple Dodecs to maximize the “diffuseness” of the chamber.**

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Temp and Humidty Worksheet					
Sample Name:		Q'Fusor Panel			
T-1					
	Time		Temperature (in C°)		Humidity
Start	7:30PM		24.94		
		Running	24.95	Running	52.0%
Stop	7:46PM		24.95		52.0%
T-2					
	Time		Temperature (in C°)		Humidity
Start	6:13PM		24.94		
		Running	24.94	Running	54.3%
Stop	6:28PM		24.94		54.0%
T-3					
	Time		Temperature (in C°)		Humidity
Start	7:12PM		24.91		52.0%
		Running	24.93	Running	52.0%
Stop	7:27PM		24.94		
T-4					
	Time		Temperature (in C°)		Humidity
Start	5:53PM		24.94		55.0%
		Running	24.95	Running	54.8%
Stop	6:10PM		24.95		

- Temperature and Humidity control is essential.
- Time after closing the door to allow the air movement to settle is also essential. (15 minutes)
- Humidity should be above 50% to stabilize the HF losses and the uncertainty in the LF areas.
- Because of the simulation requirements the frequency limits should be to extended to 10KHz, third octave.
- The order of testing needs to be set since the order of testing affects the results because of air movements that have to be controlled.
- T-4, T2 followed by T3 and then T1

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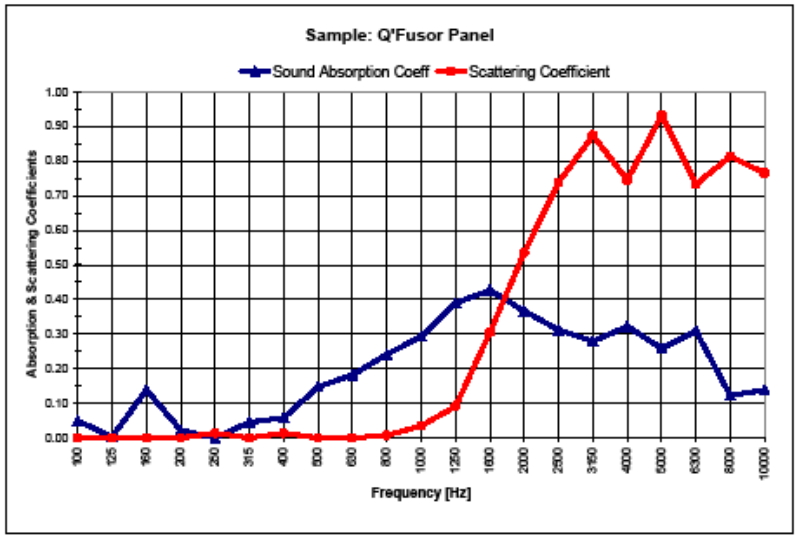
Absorption & Scattering Report

Sample Name: Q'Fusor Panel

Frequency (Hz)	Absorption Coefficient	Scattering Coefficient	Frequency (Hz)	Absorption Coefficient	Scattering Coefficient
100	0.05	0.00	1250	0.39	0.09
125	0.00	0.00	1600	0.43	0.30
160	0.14	0.00	2000	0.37	0.54
200	0.02	0.00	2500	0.31	0.74
250	0.00	0.01	3150	0.28	0.87
315	0.05	0.00	4000	0.32	0.75
400	0.06	0.01	5000	0.26	0.93
500	0.15	0.00	6300	0.31	0.73
630	0.18	0.00	8000	0.12	0.81
800	0.24	0.01	10000	0.14	0.77
1000	0.29	0.03			

NRC	0.20
SAA	0.23



- The data can be displayed as a combined chart and table but can be separate pages. The environment conditions, table and elapsed time for each section of the test should also be added.

THANKS!

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