$$D_1 = W \frac{R_1 // R_{12} \ (1 + R_2 // R_{12} C_2 s)}{1 - \frac{R_1 // R_{12} \ R_2 // R_{12}}{{R_{12}}^2} + \left(R_1 // R_{12} C_1 + R_2 // R_{12} C_2\right)s + R_1 // R_{12} \ C_1 \ R_1 // R_{12} \ C_2 s^2} \quad (35)$$

$$D_2 = W \frac{R_1 // R_{12} \frac{R_2}{R_2 + R_{12}}}{1 - \frac{R_1 // R_{12} \ R_2 // R_{12}}{{R_{12}}^2} + \left(R_1 // R_{12} C_1 + R_2 // R_{12} C_2\right)s + R_1 // R_{12} \ C_1 \ R_1 // R_{12} \ C_2 s^2} \quad (36)$$

As we can see, it is a second-order system and it can be shown that its poles are real since it is a completely dissipative system. This means that there will be a double decay slope, which is characteristic of the reverberation of acoustically coupled spaces. The effect will be more noticeable in the receiving space, especially if the coupling is weak.

VII. CONCLUSION

An approach based on circuit models has been presented for the analysis of acoustically coupled spaces. The model uses flow and force type analogies, where the flow variable is the acoustic power (the analog of the electric current) and the force variable is the volume energy density (the analog of voltage).

This approach allows to represent reverberant acoustic systems by means of a model that can be derived by simple inspection, in a similar fashion to what is customary in electric network analysis. The model is akin to the topology of the system.

Furthermore, the approach allows to profit from the vast collection of resources available for circuit resolution, a technique that has been developed for more than a century, including computer simulation.

Particularly interesting is the use of the Laplace transform, which allows to analyze the dynamics of coupled rooms, such as transient response and double or multiple reverberation slopes.

It is possible, for instance, to solve for the slopes of the energy impulse response. Of course, one should not be tempted to get the impulse response for its use in auralization since only the energy density is obtained. But it could be possible to simulate the late response applying the energy response to a suitably filtered random noise.

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