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Discussion

Reply to the comments on "The boundary point method for the calculation of exterior acoustic radiation" (by S.Y. Zhang, X.Z. Chen, *Journal of Sound and Vibration* 228(4) (1999) 761–772)

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At the outset, I want to thank Professor Sean F. Wu for showing so much interest in our paper "The boundary Point Method for the Calculation of Exterior Acoustic Radiation". Thank the JSV manager Joanna Cable for feeding back the discussion on our paper.

In the comments, professor Wu said, "the authors simply replaced the real acoustic field by this equivalent source field without any justification, which is equivalent to saying that the source strength density function is unity for the cube." But, I don't think so.

In general, the point sources distributed inside the real source surface as depicted in Fig. 1 are used to replace the real acoustic field radiated by an arbitrary structure, and each of the point sources has the source strength ω_n. Here, the point source is one of the particular solutions of the Helmholtz equation. But, the point source is singular in the nearfield. In order to overcome this shortcoming, the author uses the volume source to replace the point source as depicted in Fig. 2, and each of the volume sources has the source strength ω_n. So it is feasible to replace the real acoustic field by the equivalent field, but not without any justification.

In the calculation, the velocity potential of every volume source is given by

$$\Phi_T^*(p,q) = \int_{-h}^{+h}\int_{-h}^{+h}\int_{-h}^{+h} G(\xi,q)\,\mathrm{d}y_1\,\mathrm{d}y_2\,\mathrm{d}y_3. \tag{1}$$

In fact, when $h \to 0$, the volume source is degenerated into a point source.

If the acoustic field is approximated by the point sources or the volume sources with source strengths, the velocity potential at the field point r can be expressed as

$$\Phi(r) = \Phi_T^*(r)W, \tag{2}$$

where

$$\Phi_T^*(r) = [\Phi_{T1}^*(r), \Phi_{T2}^*(r), \ldots, \Phi_{TN}^*(r)],$$
$$W = [\omega_1, \omega_2, \ldots, \omega_N]^{\mathrm{t}},$$

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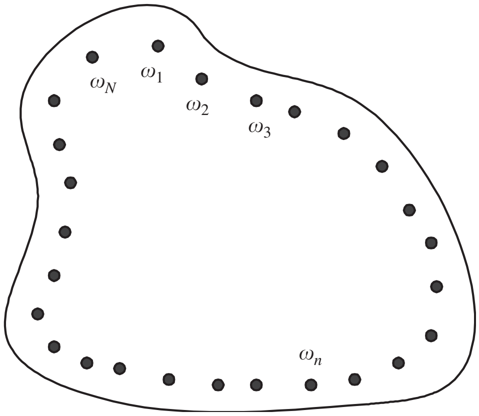

Fig. 1. The diagram of the boundary point method by using the point sources.

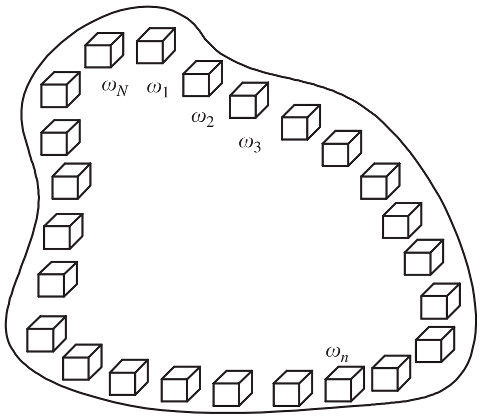

Fig. 2. The diagram of the boundary point method by using the volume source.

where $\Phi^*_{Tn}(r)$ is the velocity potential at the field point r created by the nth point source or volume source, ω_n the nth source strength, n is varied from 1 to N, and the superscript "t" means the transpose.

For the acoustic radiation calculation problem, the source strength W is determined by the surface normal velocity as

$$W = \left(\frac{\partial \Phi^*_T}{\partial \mathbf{n}}\right)^{-1} \frac{\partial \Phi}{\partial \mathbf{n}}, \tag{3}$$

where $\partial \Phi^*_T / \partial \mathbf{n}$ is created by the point source or volume sources, and $\partial \Phi / \partial \mathbf{n}$ is given by the measured surface normal velocity. Substituting Eq. (3) into Eq. (2), then Eq. (2) can be rewritten as

$$\Phi(r) = \Phi^*_T(r) \left(\frac{\partial \Phi^*_T}{\partial \mathbf{n}}\right)^{-1} \frac{\partial \Phi}{\partial \mathbf{n}}. \tag{4}$$

It is obvious that the source strength is considered in the above-mentioned formulas. In fact, Eq. (4) is just Eq. (11) in the published paper. In our paper, the equation is obtained in another approach, and the source strength is included in the equation.