Errata: Adaptive Vibration Suppression System: An Iterative Control Law for a Piezoelectric Actuator Shunted by a Negative Capacitor

Miloš Kodejška, Pavel Mokrý, Václav Linhart, Jan Václavík, and Tomáš Sluka

The objective of this article is to make a correction to our previously published results [1] on the adaptive vibration suppression system. The vibration suppression system consists of a piezoelectric actuator of electric impedance Z_S, which is connected to an active shunt circuit of electric impedance Z. In this situation, the effective spring constant of the piezoelectric actuator K_{eff} is controlled by the value of the connected shunt impedance Z. It is shown in the article [1] that when the effective spring constant of the piezoelectric actuator K_{eff} reaches small values (ideally zero value), the transmissibility of vibrations through the piezoelectric element greatly decreases.

According to [1, Eq. (7)], a situation in which the effective value of the spring constant K_{eff} of the piezoelectric actuator effectively reaches zero at given critical frequency ω_0 is characterized by the condition

$$Z_S(\omega_0)/Z(\omega_0) = -1.$$

Because the impedances of the piezoelectric actuator Z_S and the negative capacitor Z are generally complex values, this condition implies corresponding conditions for absolute values and arguments of impedances Z_S and Z. Unfortunately, there is an error in these conditions as presented in [1, Eq. (12)]. The correct form of the conditions for absolute values and arguments of impedances Z_S and Z should be determined as follows: the condition $Z_S(\omega_0)/Z(\omega_0) = -1$ is satisfied when the absolute values of Z_S and Z are equal and the arguments of Z_S and Z are shifted exactly by π. Thus, [1, Eq. (12)] should read

$$|Z(\omega_0)| = |Z_S(\omega_0)|, \quad (1a)$$

$$\arg[Z(\omega_0)] = \arg[Z_S(\omega_0)] + \pi. \quad (1b)$$

All remaining formulas in [1] remain valid.

As a result of the correction to [1, Eq. (12)] given by (1), it is necessary to present a modification to [1, Figs. 3(c) and 5(c)], which graphically represent the condition given by (1b). Fig. 1 shows the corrected [1, Fig. 3(c)]. The black line with filled circles shows the measured values of the electric impedance argument $\arg[Z_S(\omega)]$ of the piezoelectric actuator. The dashed, dot-dashed, and double-dot-dashed lines represent the calculated values of the electric impedance argument of the negative capacitor, which were decreased by π, i.e., $\arg[Z(\omega)] - \pi$, for three adjustments of the negative capacitor.

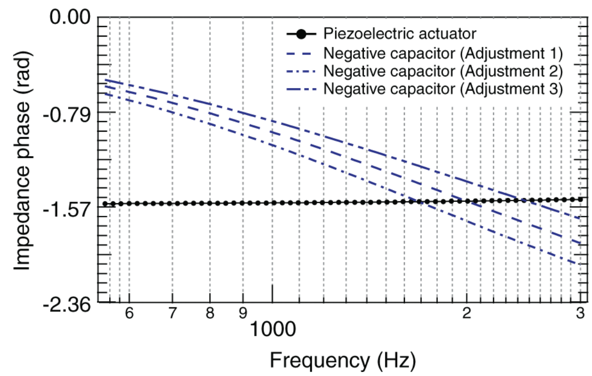

Fig. 1. Modified [1, Fig. 3(c)], which shows the frequency dependence of the phase of the electric impedances of the piezoelectric actuator (measured) and of the negative capacitor (calculated and subtracted by π).

Fig. 2 shows the corrected [1, Fig. 5(c)]. Filled circles indicate measured values of the electric impedance ar-

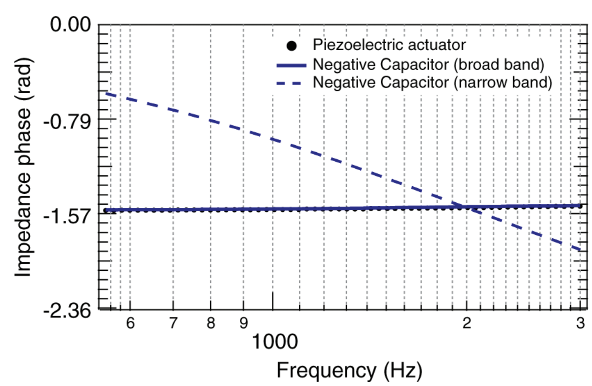

Fig. 2. Modified [1, Fig. 5(c)], which shows the frequency dependence of the phase of the electric impedances of the piezoelectric actuator (measured) and of the negative capacitor (calculated and subtracted by π). Filled circles show the phase of the piezoelectric actuator impedance. Dashed and solid lines show the impedance phase of the negative capacitor with narrow and broad frequency ranges adjusted at 2 kHz.

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M. Kodejška, P. Mokrý, V. Linhart, and J. Václavík are with the Faculty of Mechatronics, Informatics and Interdisciplinary Studies, Technical University of Liberec, Liberec, Czech Republic (e-mail: pavel.mokry@tul.cz).

P. Mokrý and J. Václavík are with the Research Centre for Special Optics and Optoelectronic Systems (TOPTEC), Turnov, Czech Republic.

T. Sluka is with the Ceramics Laboratory, Swiss Federal Institute of Technology (EPFL), Lausanne, Switzerland.

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gument $\arg[Z_S(\omega)]$of the piezoelectric actuator. Dashed and solid lines show the impedance phase of the negative capacitor, which were decreased by π, i.e., $\arg[Z(\omega)] - \pi$, with narrow and broad frequency ranges adjusted at 2 kHz, respectively. In Fig. 2, there is noticeable perfect agreement (in a broad frequency range) of the measured values of the electric impedance argument of the piezoelectric actuator with the calculated values of the electric impedance argument of the negative capacitor. This is in perfect accord with the results and their discussion presented in [1].

References

[1] M. Kodejska, P. Mokry, V. Linhart, J. Vaclavik, and T. Sluka, "Adaptive vibration suppression system: an iterative control law for a piezoelectric actuator shunted by a negative capacitor," *IEEE Trans. Ultrason. Ferroelectr. Freq. Control*, vol. 59, pp. 2785–2796, Dec. 2012.