Erratum

Erratum to "Thin-Film Silicon MEMS for Dynamic Mass Sensing in Vacuum and Air: Phase Noise, Allan Deviation, Mass Sensitivity and Limits of Detection"

Rui M. R. Pinto, Pedro Brito, Virginia Chu, *Senior Member, IEEE*, and João Pedro Conde

In the above article [1], which consists in the application of phase noise theory for the prediction of MEMS mass limit of detection, an error was found in Eq. (10). The error resulted in the overestimation of the frequency resolution (Δf_{min}) and the limit of detection (*LoD*). A few other typos were also detected and we take the opportunity to correct them here, for the benefit of the reader. The *errata* follows below:

Main Text

p.390, in the Abstract

For:

"The limits of detection were calculated to be 100-833 fg in vacuum and 37-846 pg at atmospheric pressure."

Read:

"The limits of detection were calculated to be 3-28 fg in vacuum and 1-28 pg at atmospheric pressure."

p.391, Eq. (9)

For the *LoD* to come as a positive quantity, the absolute value of the mass sensitivity ($|S|$) should be used instead of S.

Eq. (9) should read:

$$LoD = 3\frac{\Delta f_{min}}{|S|} \tag{9}$$

p.391, last sentence, and Eq. (10)

In the original manuscript, the inclusion of the integration time (τ) in Eq. (10) resulted in a units mismatch.

For:

"For a given integration time, τ, the root mean square value of the frequency deviation, Δf_{min}, can be calculated:..."

Read:

"Then, the root mean square value of the frequency deviation, Δf_{min}, can be calculated"

$$\left[\sigma_y(\tau)\right]^2 = \left[\frac{\Delta f_{min}}{f_{res}}\right]^2 \Leftrightarrow \Delta f_{min} = \sigma_y(\tau)\, f_{res} \tag{10}$$

p. 393, below Eq. (13)

For:

"The Δf_{min} for an integration time $\tau = 30$ sec was calculated using (10) and the mass *LoD* estimated for each resonator and each condition (vacuum and air). The integration time chosen for the $\sigma_y(\tau)$ and Δf_{min} calculation was 30 sec because this is the average time required to acquire a full spectrum (401 points) in the spectrum analyzer (typical sweep times are 26 sec in vacuum and 44 sec at atmospheric pressure)."

Read:

"The Δf_{min} was calculated using (10) and the mass *LoD* estimated for each resonator and each condition (vacuum and air). The integration time chosen for the $\sigma_y(\tau)$ calculation was 30 sec because this is the average time required to acquire a full spectrum (401 points) in the spectrum analyzer (typical sweep times are 26 sec in vacuum and 44 sec at atmospheric pressure)."

p. 393, fifth paragraph

There was a repetition of words.

For

"The expected decrease in mass sensitivity is 44 % for the 20 μm-long cantilever, 22 % for the 30 μm-long cantilever, 46 % for the 30 μm-long cantilever and 56 % for the 30 μm-long cantilever."

Read:

"The expected decrease in mass sensitivity is 44 % for the 20 μm-long cantilever, 22 % for the 30 μm-long cantilever, 46 % for the 40 μm-long cantilever and 56 % for the 60 μm-long cantilever."

p. 396, second paragraph

For:

"Using the experimental values of S_{vac} from the SiO_2 added mass experiment, and taking the optimized Δf_{min} for each sensor, the *LoD* values were estimated, using (9), to be in the range of 100–833 fg in vacuum and 37–846 pg at atmospheric pressure (refer to Table S2 for the individual values)."

Read:

"Using the experimental values of S_{vac} from the SiO_2 added mass experiment, and taking the optimized Δf_{min} for each sensor, the *LoD* values were estimated, using (9), to be in the

Manuscript received 1 March 2024; accepted 7 March 2024. Date of publication 21 March 2024; date of current version 4 June 2024. Subject Editor S.-S. Li. *(Corresponding author: Rui M. R. Pinto.)*

Rui M. R. Pinto was with the Instituto de Engenharia de Sistemas e Computadores–Microsistemas e Nanotecnologias (INESC-MN), 1000-029 Lisbon, Portugal. He is now with the International Iberian Nanotechnology Laboratory (INL), 4715-330 Braga, Portugal (e-mail: rui.pinto@inl.int).

Pedro Brito was with the Instituto de Engenharia de Sistemas e Computadores–Microsistemas e Nanotecnologias (INESC-MN), 1000-029 Lisbon, Portugal. He is now with SISCOG, 1700-097 Lisboa, Portugal.

Virginia Chu is with the Instituto de Engenharia de Sistemas e Computadores–Microsistemas e Nanotecnologias (INESC-MN), 1000-029 Lisbon, Portugal.

João Pedro Conde is with the Instituto de Engenharia de Sistemas e Computadores–Microsistemas e Nanotecnologias (INESC-MN), 1000-029 Lisbon, Portugal, and also with the Department of Bioengineering, Instituto Superior Técnico, 1049-001 Lisbon, Portugal.

Color versions of one or more figures in this article are available at https://doi.org/10.1109/JMEMS.2024.3375930.

Digital Object Identifier 10.1109/JMEMS.2024.3375930

range of ∼3-28 fg in vacuum and ∼1-28 pg at atmospheric pressure (refer to Table S2 for the individual values)."

p. 396, third paragraph

For:

"Thus, with the 20 μm-long cantilever, we would be able detect 37 bacteria in air (using an aerosol or a nozzle sample dispersion system)."

Read:

"Thus, with the 20 μm-long cantilever, we would be able to detect a single bacteria in air (using an aerosol or a nozzle sample dispersion system)."

p.396, fifth paragraph

For:

"In this regime, before coalescence, it is possible to confirm that the mass resolution, or *LoD*, is of the order of hundreds of fg, as predicted in the previous section."

Read:

"In this regime, before coalescence, it is possible to confirm that the mass resolution, or *LoD*, is below 100 fg, as predicted in the previous section."

p.398, first paragraph

For:

"The *LoD* values predicted at atmospheric pressure are 37 pg, 93 pg and 152 pg, for the 20, 30 and 40 μm-long cantilevers. However, the maximum masses deposited in this experiment were 3.6 pg, 0.9 pg and 7.4 pg, respectively, thus we are well below the *LoD* at atmospheric pressure."

Read:

"The *LoD* values predicted at atmospheric pressure are 1.2 pg, 3.1 pg and 5.1 pg, for the 20, 30 and 40 μm-long cantilevers. However, the maximum masses deposited in this experiment were 3.6 pg, 0.9 pg and 7.4 pg, respectively, which are of the same order or smaller than the *LoD* at atmospheric pressure, thus the mass detection was not possible in this case."

Supplementary Information

p.1

Eq. (S1), identical to Eq. (9) should read:

$$LoD = 3\frac{\Delta f_{min}}{|S|} \tag{S1}$$

p.2

There was an unintended "=" sign in the exponent of f. Eq. (S4) should read:

$$S_\Phi(f) = \left\{ \begin{array}{ll} \sum_{\alpha=-2}^{+2} f_0^2 h_\alpha f^{\alpha-2} & for\ 0 < f < f_h \\ 0 & for\ f \geq f_h \end{array} \right\} \tag{S4}$$

Eq. (S6), identical to Eq. (10), should read:

$$[\sigma_y(\tau)]^2 = \left[\frac{\Delta f_{min}}{f_{res}}\right]^2 \Leftrightarrow \Delta f_{min} = \sigma_y(\tau) f_{res} \tag{S6}$$

p.4,

Table S2 should be updated with regards to the minimum detectable frequency shift and mass limit of detection [consequence of the correction of Eq. (10)].

References

[1] R. M. R. Pinto, P. Brito, V. Chu, and J. P. Conde, "Thin-film silicon MEMS for dynamic mass sensing in vacuum and air: Phase noise, Allan deviation, mass sensitivity and limits of detection," *J. Microelectromech. Syst.*, vol. 28, no. 3, pp. 390–400, Jun. 2019, doi: 10.1109/JMEMS.2019.2911666.

		Cantilever Sensor Length, *l* (μm)			
		20	**30**	**40**	**60**
Minimum Detectable Frequency Shift, Δf_{min} (using eq. 10)	Vacuum (Hz)	5.1	2.2	1.5	0.9
	Atm. Press. (kHz)	1.92	1.10	0.66	0.92
Mass Limit of Detection, *LoD* (using using eq. 9 and considering the mass sensitivities from the distributed SiO_2 experiment)	Vacuum (fg)	3.3	6.2	11.5	27.7
	Atm. Press. (pg)	1.2	3.1	5.1	28.2