# Momentum predictability and heat accumulation in laser-based space debris removal (Erratum)

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This article [Opt. Eng. 58(1), 011004 (2018), doi: https://doi.org/10.1117/1.OE.58.1.011004] was originally published with two errors.

**Momentum Coupling**

Equation (13) originally appeared as

$$\Phi_{opt} = \Phi_0 - (1/c - 1)\Delta\Phi/2 + q$$

but should read as

$$\Phi_{opt} = \Phi_0 + (1/c - 1)\Delta\Phi/2 + q.$$

It can be confirmed, however, that data shown in Fig. 4 has been computed correctly and is not affected by the typo that had occurred in Eq. (13).

**Laser Pointing Accuracy**

Additionally, re-initialization of the target position in the Monte Carlo simulations of Sec. 5.2 had been corrupted by a numerical bug yielding the target to walk off the laser beam after a multitude of Monte Carlo samples. Revised results from the Monte Carlo simulation with proper target re-initialization are shown in Fig. 1. The impact of target walk-off on the combined efficiency in the depicted data range amounts to a decrease by 2 (for large initial offsets) up to 4 (for small initial offsets). Correspondingly, the single sample data of the Monte Carlo study scatter significantly less when the target is re-initialized properly and does not exhibit beam walk-off.

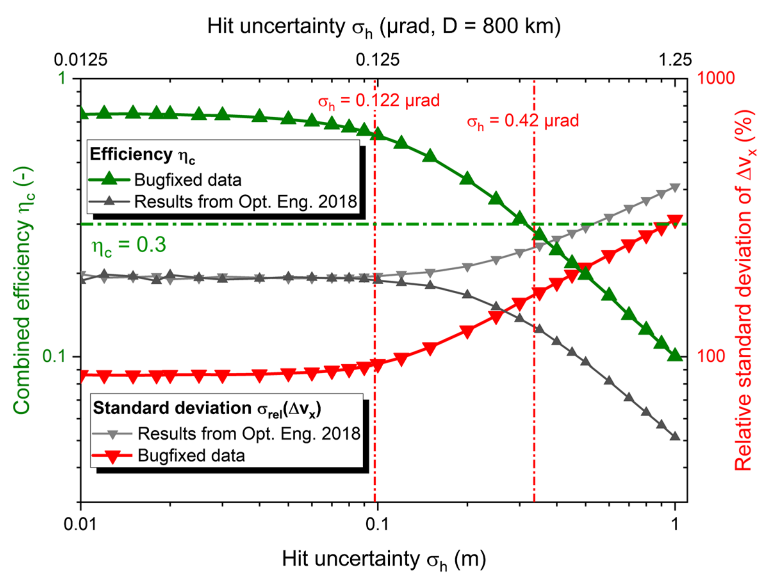


**Fig. 1** Combined efficiency $\eta_c$ and relative standard deviation $\sigma_{\Delta v_{ax}}/\langle \Delta v_{ax} \rangle$ of the axial velocity increment: dependency on hit uncertainty. Comparison of simulation results shown in Fig. 8 of Opt. Eng. 58(1), 011004 (2018) with revised data after numerical bugfixing.

In the explaining text of Sec. 5.2 the end of the third paragraph should then read:

"In the case of a very low-hit uncertainty up to ≈10 cm corresponding to the uncertainty contributions considered in Ref. 8, $\sigma_\mathrm{h} = \sqrt{\sigma_\mathrm{t}^2 + \sigma_\mathrm{p}^2} = 0.122\ \mu\mathrm{rad}$, the combined coupling efficiency is rather constant at a level of $\eta_\mathrm{c} \approx 0.7$. Moreover, the relative error of $\Delta \mathrm{v}_\mathrm{ax}$ increases from 86%, cf. the previous section, to ≈300%, which implies a relative uncertainty due to positioning errors of up to ≈290%."

Compared to Phipps' estimate from Ref. 9 for the combined efficiency, $\eta_c \approx 0.3$, cf. Sec. 2.2 of our paper, this estimate is exceeded by a factor of up to 2 - 2.5 for significantly small hit uncertainties not exceeding 10 cm. For greater (and more realistic) hit uncertainties exceeding 30 cm, however, Phipps' estimate appears to be rather more optimistic than the findings from our simulations.

The general decreasing tendency of combined coupling efficiency with increasing hit uncertainty is unchanged compared to the former version of our paper, hence, the conclusion on hit accuracy requirements made in the subsequent paragraph of Sec. 5.2 is not affected.

The paper was corrected on 14 March 2022.