Comments and Corrections

Corrections to "Model-Based Design of the COAST Guidewire Robot for Large Deflection"

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1) In Section III-B, the sentence, "Therefore, the total pre-curvature in any given telescoping combination of outer and middle tubes will be considered and is given by $\int_{s=0}^{L} |\kappa_{final}(s)|$." **is corrected to:** "Therefore, for any given telescoping combination of outer and middle tubes, the total curvature, a measure of the deviation from zero curvature, is given by $\sum_{j=1}^{N_{load}} |\kappa_{final}(s^j)|$." – In addition of other corrections in the sentence, the integral has been changed to a summation. This does not change the numerical values since the equation for the total curvature had been used for computation in [1].
2) The y-axis label in both Fig. 8(a) and (b) **is corrected to** "Total Curvature (m^{-1})" **from** "Total Curvature".
3) The x-axis label of Fig. 8(b) **is corrected to** "Flexural Stiffness ($N.m^3$)" from "Flexural Rigidity".
4) The term $\int_{s=0}^{L} I_{out}(s) + I_{mid}(s)$ was used incorrectly to denote "Flexural Rigidity" in [1]. Instead, we define "Flexural Stiffness" as $\int_{s=0}^{L} E[I_{out}(s) + I_{mid}(s)]ds$. This does not change the numerical values in Fig. 8, since the correct equation for "Flexural Stiffness" as defined above had been used for computation in [1].
5) The following in [1] need to be corrected, namely:
   - In the Abstract, the sentence: "**This includes the introduction of a mechanical model that accounts for micromachining-induced pre-curvatures with the goal of determining design parameters that reduce combined distal tip pre-curvature and minimize abrupt changes in actuated tip position for the COAST guidewire robot through selection of the best flexural rigidity between the tube pairs.**" is corrected to:" **This includes the introduction of a mechanical model that accounts for micromachining-induced pre-curvatures with the goal of determining design parameters that reduce combined distal tip pre-curvature and minimize abrupt changes in actuated**

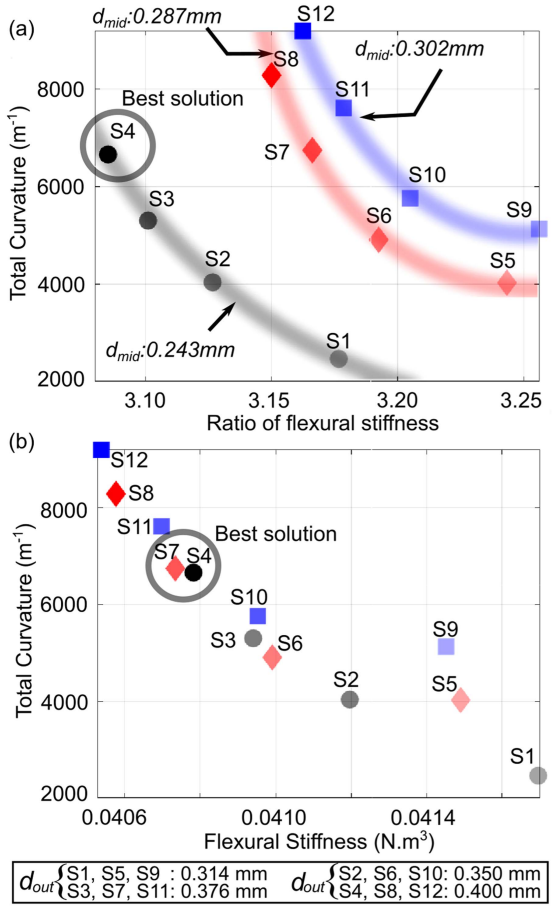

Fig. 8. (a) Graph of the total curvature of the combined tube samples vs. the flexural stiffness ratio of the outer to the middle tube – The shaded lines are shown to indicate the trends when varying d_{out} and keeping d_{mid} as constant. (b) Graph of the total curvature of the combined tube samples vs. flexural stiffness. Depths of the middle and outer tubes are given by d_{mid} and d_{out}, respectively.

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tip position for the COAST guidewire robot through selection of the best flexural stiffness between the tube pairs." – The term "flexural rigidity" is corrected to "flexural stiffness", in the above sentence in [1].

- In Section I, the sentence, "To address this, a design procedure is developed for the COAST guidewire robot to determine machining parameters based on desired combined tube precurvature and the flexural rigidity ratio between the tubes to reduce abrupt changes in the guidewire shape, commonly refered to as "snapping' motion." **is corrected to:** "To address this, a design procedure is developed for the COAST guidewire robot to determine machining parameters based on desired combined tube pre-curvature and the flexural stiffness ratio between the tubes to reduce abrupt changes in the guidewire shape, commonly referred to as "snapping' motion." – The term "flexural rigidity" is corrected to "flexural stiffness" and "refered" is corrected to "referred", in the above sentence in [1].
- In Section I, the sentence, "We present a systematic approach to find the best tube pair for the COAST guidewire robot which uses a large deflection beam-bending model (derived in this work) and analysis of the coaxial-tube assembly for different notch depths to achieve the desired moderate flexural rigidity, and desired low total combined pre-curvature." **is corrected to:** "We present a systematic approach to find the best tube pair for the COAST guidewire robot which uses a large deflection beam-bending model (derived in this work) and analysis of the coaxial-tube assembly for different notch depths to achieve the desired moderate flexural stiffness, and desired low total combined pre-curvature." – The term "flexural rigidity" is corrected to "flexural stiffness", in the above sentence in [1].
- In Section III, the sentence, "In addition to a desired flexural rigidity, a pair of tubes that results in the lowest combined pre-curvature (ideally, no combined pre-curvature) is desired so that the unactuated robot tip is straight and bends only when the tendon is actuated." **is corrected to:** "In addition to a desired flexural stiffness, a pair of tubes that results in the lowest combined pre-curvature (ideally, no combined pre-curvature) is desired so that the unactuated robot tip is straight and bends only when the tendon is actuated." – The term "flexural rigidity" is corrected to "flexural stiffness", in the above sentence in [1].
- The caption in Fig. 8, "(a) Graph of flexural rigidity ratios of the outer to the middle tube vs. total curvature in the combined tube samples. (The shaded lines are shown to indicate the trends when varying d_{out} and keeping d_{mid} as constant), (b) Graph of flexural rigidity vs. total combined curvature. Depths of the middle and outer tubes are given by d_{mid} and d_{out} respectively (adapted from [14])." **is corrected to:** "(a) Graph of the total curvature of the combined tube samples vs. the flexural stiffness ratio of the outer to the middle tube – The shaded lines are shown to indicate the trends when varying d_{out} and keeping d_{mid} as constant. (b) Graph of the total curvature of the combined tube samples vs. flexural stiffness. Depths of the middle and outer tubes are given by d_{mid} and d_{out}, respectively." – In addition to other corrections, the term "flexural rigidity" is corrected to "flexural stiffness" and the term "total combined curvature" is corrected to "total curvature", in the above caption in [1].
- In Section IV-B, the sentence, "The plot in Fig. 8(a) displays the ratios of the flexural rigidity of the outer-tube to that of the middle tube ($\int_{s=0}^{L} I_{out}(s)/\int_{s=0}^{L} I_{mid}(s)$) vs. the total pre-curvature ($\int_{s=0}^{L} |\kappa_{final}(s)|$) for each sample." **is corrected to:** "The plot in Fig. 8(a) displays the total curvature ($\sum_{j=1}^{N_{load}} |\kappa_{final}(s^j)|$) for each combined tube sample vs. the ratio of the flexural stiffness of the outer-tube to that of the middle tube ($\int_{s=0}^{L} I_{out}(s)\mathrm{d}s/\int_{s=0}^{L} I_{mid}(s)\mathrm{d}s$)." – In addition to other corrections, the term "flexural rigidity" is corrected to "flexural stiffness", in the above sentence in [1].
- In Section IV-B, the sentence, "Furthermore, Fig. 8(b) represents a graph of flexural rigidity of the samples ($\int_{s=0}^{L} I_{out}(s) + I_{mid}(s)$) vs. the total pre-curvature in the samples." **is corrected to:** "Furthermore, Fig. 8(b) represents a graph of the total curvature for each combined tube sample vs. the flexural stiffness of the samples ($\int_{s=0}^{L} E[I_{out}(s) + I_{mid}(s)]\mathrm{d}s$)" – In addition to other corrections, the term "flexural rigidity" is corrected to "flexural stiffness", and the terms, "E" and "$\mathrm{d}s$" are added to the integral, in the above sentence in [1].
- In Section IV-B, the sentence, "The shaded lines are shown in Fig. 8(a) to indicate the total curvature vs. ratio of rigidity trends when varying outer tube notch depths (d_{out}) and keeping the middle tube notch depth as constant (d_{mid})." **is corrected to:** "The shaded lines are shown in Fig. 8(a) to indicate the total curvature vs. ratio of flexural stiffness trends when varying outer tube notch depths (d_{out}) and keeping the middle tube notch depth as constant (d_{mid})." – The term "ratio of rigidity" is corrected to "ratio of flexural stiffness", in the above sentence in [1].
- In Section IV-B, the sentence, "We observe that sample S1 has the lowest predicted pre-curvature, but suffers from relatively higher dominance of the outer tube's rigidity in comparison to sample S4, which demonstrates lowest rigidity ratio (see Fig. 8(a))." **is corrected to:** "We observe that sample S1 has the lowest total pre-curvature, but suffers from relatively higher dominance of the outer tube's stiffness in comparison to sample S4, which demonstrates the lowest flexural stiffness ratio (see Fig. 8(a))." – The term "predicted pre-curvature" is corrected to "total pre-curvature", "rigidity" is corrected to "stiffness", and the term "rigidity ratio" is corrected to "flexural stiffness ratio", in addition to adding "the", in the above sentence in [1].
- In Section IV-B, the sentence, "In fact, sample S1 demonstrates the highest total flexural rigidity and hence may be unsuitable for a guidewire application due to the risk of vascular perforation (see Fig. 8(b)) upon tip contact with the vessel walls." **is corrected to:** "In fact, sample S1 demonstrates the highest total flexural stiffness and hence may be unsuitable for a guidewire application due to the risk of vascular perforation (see Fig. 8(b)) upon tip contact with the vessel walls." – The term "flexural rigidity" is corrected to "flexural stiffness", in the above sentence in [1].
- In Section IV-B, the sentence, "The ratio of flexural rigidities for the tube pair is desired to be close to unity so that the rigidity of the one tube does not dominate the other, which further leads to a non-zero combined curvature." **is corrected to:** "The ratio of the flexural stiffness for the tube pair is desired to be close to unity so that the stiffness of one tube does not dominate the other tube, which further leads to a non-zero combined curvature." – In addition to other corrections, the term "flexural rigidities" is corrected to "flexural stiffness" and "rigidity" is corrected to "stiffness", in the above sentence in [1].
- In Section IV-B, the sentence, "For moderate to high total combined curvatures of the tube pairs, such that the robot curved in the direction of the outer tube (when its rigidity

was dominant), an initial snapping motion was observed upon actuating the tendon stroke to a certain value as the curvature of the robot switched to being dictated by the actuated middle tube's bending length." **is corrected to:** "For moderate to high total combined curvatures of the tube pairs, such that the robot curved in the direction of the outer tube (when its stiffness was dominant), an initial snapping motion was observed upon actuating the tendon stroke to a certain value as the curvature of the robot switched to being dictated by the actuated middle tube's bending length." – The term "rigidity" is corrected to "stiffness", in the above sentence in [1].

- In Section IV-B, the sentence, "To achieve the requirements of the parameters as described above, we therefore selected sample S4 ($d_{mid} = 0.243$ mm and $d_{out} = 0.400$ mm) as our best sample with the combination of relatively low rigidity, minimal pre-curvature, and ratio of flexural rigidity closest to unity, resulting in no observed snapping motion." **is corrected to:** "To achieve the requirements of the parameters as described above, we therefore selected sample S4 ($d_{mid} = 0.243$ mm and $d_{out} = 0.400$ mm) as our best sample with the combination of relatively low flexural stiffness, minimal pre-curvature, and ratio of flexural stiffness closest to unity, resulting in no observed snapping motion." – The term "low rigidity" is corrected to "low flexural stiffness" and the term "ratio of flexural rigidity" is corrected to "ratio of flexural stiffness", in the above sentence in [1].

REFERENCE

[1] Y. Chitalia, A. Sarma, T. A. Brumfiel, N. J. Deaton, M. Sheft, and J. P. Desai, "Model-based design of the COAST guidewire robot for large deflection," *IEEE Robot. Automat. Lett.*, vol. 8, no. 9, pp. 5345–5352, Sep. 2023.