Microfluidics-integrated spaceflight hardware for measuring muscle strength of Caenorhabditis elegans on the International Space Station

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Supplementary Table 1: Swim-induced thrashing frequency of gravid adults as a measure of their locomotory health. The number of body bends was manually counted under a dissecting microscope for 40 random individual worms for a period of 20s at room temperature. There is no significant difference between thrashing frequency as calculated by one-way ANOVA, $P \geq 0.7$.

| Time Point | thrashing frequency (1/min) |
|------------|-----------------------------|
| Week 2     | 108.3±22.6                  |
| Week 4     | 109.9.3±16.4                |
| Week 6     | 110.2±19.6                  |
| Week 8     | 109.3±15.7                  |

Supplementary Table 2: Breakup of time required for loading the worms into the NemaFlex-S Chamber. It approximately takes 17 minutes to load one NemaFlex-S device.

| step | Operational steps                                      | Time required | Manual/Automatic |
|------|--------------------------------------------------------|---------------|------------------|
| 1    | Turn distribution valve towards waste syringe         | 2 sec         | manual           |
| 2    | Infuse 1mL CeMM to waste syringe @ 1000 mL/hr         | 4 sec         | automated        |
| 3    | Mix worm culture bag, and connect FEP culture bag to distribution valve port | 30 sec | manual |
| 4    | Turn valve to FEP culture bag                         | 2 sec         | manual           |
| 5    | Withdraw 400 µL worm aliquot @ 400 mL/hr from culture bag | 4 sec | automated |
| 6    | Turn valve toward waste collection                    | 2 sec         | manual           |
| 7    | Infuse the worm aliquot to waste @ 400 mL/hr          | 4 sec         | automated        |
| 8    | Disconnect FEP culture bag and mix it well and connect back to distribution valve | 45 sec | manual |
| 9    | Turn valve to FEP culture bag and hit loading protocol on pump | 2 sec | manual |
| 10   | Withdraw 400 µL worm aliquot @ 400 mL/hr from culture bag | 4 sec | Automated |
| 11   | Turn valve towards NemaFlex-S A side                  | 2 sec         | manual           |
| 12   | Load worms into chambers and wash it with 1500µL CeMM @ 25 ml/hr | 7 min 10 sec | Automated |
| 13   | Repeat step 8 to 12 for NF-B                           | 8 min         |                  |
Supplementary Table 3: Effect of flow rate used for worm trapping on loading efficacy at a fixed worm suspension volume of 300 µL. The density of animals in the culture bag was 1060±160 adults/mL.

| Number of worms in a chamber | Number of chambers occupied at 5mL/hr | Number of chambers occupied at 7 mL/hr |
|-----------------------------|-------------------------------------|-------------------------------------|
| 0                           | 30±1                                | 29±3                                |
| 1 - 2                       | 25±1                                | 29±3                                |
| 3 - 4                       | 5±1                                 | 2±1                                 |
| More than 4                 | 0                                   | 0                                   |

Supplementary Table 4: Effect of worm suspension volume on the loading efficacy at a fixed trapping flow rate of 7mL/hr. The density of animals in the culture bag was 1060±160 adults/mL.

| Number of worms in a chamber | Number of chambers occupied for 300 µL aliquot | Number of chambers occupied for 400 µL aliquot | Number of chambers occupied for 500 µL aliquot |
|-----------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|
| 0                           | 29±3                                          | 24±2                                          | 19±3                                          |
| 1 - 2                       | 29±3                                          | 31±2                                          | 29±1                                          |
| 3 - 4                       | 2±1                                           | 5±1                                           | 8±1                                           |
| More than 4                 | 0                                             | 0                                             | 4±3                                           |

Supplementary Table 5: Summary of the worm diameter and force value for different time points during a multigenerational study on the ground.

| Time Point | Sample Size | Worm diameter (µm) | $f_{25}$ (µN) |
|------------|-------------|--------------------|--------------|
| Week 2     | 32          | 47.76±2.78         | 15.17±5.34   |
| Week 4     | 36          | 48.64±3.16         | 16.12±5.49   |
| Week 6     | 38          | 49.08±2.57         | 15.51±3.70   |
| Week 8     | 41          | 48.63±2.65         | 16.33±4.54   |

Supplementary Movie 1: Worm trapping and loading into the NemaFlex-S chamber.