Table 1: Positional error: Average error is computed for the last 300 nodes, i.e. for the last 0.6 s of the trajectory. We used a factor of 1 for the integration time, i.e. the integration constant is 0.002 s with a real-time control frequency of 500 Hz. Bold types of minimum values are considered experiment (i.e. row) wise.

direction	radius	orientation	5-standard	10-standard	20-standard	5-standard-angled	10-standard-angled	20-standard-angled	5-rotated	10-rotated	20-rotated	5-human	10-human	20-human
x	0.05	−1	$1.139 \cdot 10^{+00}$	$6.740 \cdot 10^{-02}$	$1.533 \cdot 10^{+00}$	$1.007 \cdot 10^{-01}$	$1.025 \cdot 10^{-01}$	$8.980 \cdot 10^{-03}$	$7.370 \cdot 10^{-01}$	$2.598 \cdot 10^{-01}$	$9.909 \cdot 10^{-02}$	$8.918 \cdot 10^{-01}$	$1.033 \cdot 10^{+00}$	$\mathbf{6.154 \cdot 10^{-03}}$
x	0.05	+1	$1.270 \cdot 10^{-01}$	$2.848 \cdot 10^{-01}$	$6.524 \cdot 10^{-01}$	$9.224 \cdot 10^{-02}$	$9.867 \cdot 10^{-02}$	$\mathbf{8.709 \cdot 10^{-03}}$	$6.094 \cdot 10^{-01}$	$2.927 \cdot 10^{-01}$	$1.000 \cdot 10^{-01}$	$1.227 \cdot 10^{+00}$	$1.008 \cdot 10^{+00}$	$4.748 \cdot 10^{-02}$
x	0.10	−1	$1.265 \cdot 10^{+00}$	$9.192 \cdot 10^{-01}$	$1.536 \cdot 10^{+00}$	$9.492 \cdot 10^{-02}$	$1.018 \cdot 10^{-01}$	$\mathbf{1.509 \cdot 10^{-02}}$	$7.859 \cdot 10^{-01}$	$1.816 \cdot 10^{-01}$	$1.047 \cdot 10^{-01}$	$8.925 \cdot 10^{-01}$	$9.279 \cdot 10^{-01}$	$3.055 \cdot 10^{-02}$
x	0.10	+1	$1.537 \cdot 10^{-01}$	$9.119 \cdot 10^{-01}$	$1.380 \cdot 10^{-01}$	$8.908 \cdot 10^{-01}$	$1.016 \cdot 10^{-01}$	$\mathbf{1.402 \cdot 10^{-02}}$	$1.064 \cdot 10^{-01}$	$1.409 \cdot 10^{-01}$	$9.211 \cdot 10^{-02}$	$9.992 \cdot 10^{-01}$	$1.076 \cdot 10^{+00}$	$7.170 \cdot 10^{-02}$
x	0.15	−1	$4.400 \cdot 10^{-01}$	$9.514 \cdot 10^{-01}$	$1.934 \cdot 10^{+00}$	$9.670 \cdot 10^{-02}$	$1.092 \cdot 10^{-01}$	$\mathbf{2.166 \cdot 10^{-02}}$	$8.932 \cdot 10^{-01}$	$2.876 \cdot 10^{-01}$	$1.135 \cdot 10^{-01}$	$9.979 \cdot 10^{-01}$	$8.131 \cdot 10^{-01}$	$5.819 \cdot 10^{-02}$
x	0.15	+1	$2.525 \cdot 10^{-01}$	$1.987 \cdot 10^{+00}$	$7.651 \cdot 10^{-01}$	$9.260 \cdot 10^{-02}$	$1.051 \cdot 10^{-01}$	$\mathbf{1.953 \cdot 10^{-02}}$	$8.831 \cdot 10^{-01}$	$4.319 \cdot 10^{-01}$	$4.677 \cdot 10^{-02}$	$9.418 \cdot 10^{-01}$	$1.179 \cdot 10^{+00}$	$9.854 \cdot 10^{-02}$
y	0.05	−1	$1.881 \cdot 10^{-01}$	$1.071 \cdot 10^{+00}$	$5.065 \cdot 10^{-02}$	$1.160 \cdot 10^{-01}$	$1.026 \cdot 10^{-01}$	$9.908 \cdot 10^{-03}$	$6.832 \cdot 10^{-01}$	$1.965 \cdot 10^{-01}$	$1.131 \cdot 10^{-01}$	$1.148 \cdot 10^{+00}$	$9.777 \cdot 10^{-01}$	$\mathbf{6.324 \cdot 10^{-03}}$
y	0.05	+1	$1.740 \cdot 10^{-01}$	$3.148 \cdot 10^{-01}$	$4.894 \cdot 10^{-01}$	$1.049 \cdot 10^{-01}$	$1.074 \cdot 10^{-01}$	$\mathbf{9.100 \cdot 10^{-03}}$	$7.145 \cdot 10^{-01}$	$5.243 \cdot 10^{-01}$	$9.136 \cdot 10^{-02}$	$1.065 \cdot 10^{+00}$	$6.272 \cdot 10^{-01}$	$1.601 \cdot 10^{-01}$
y	0.10	−1	$3.851 \cdot 10^{-01}$	$1.267 \cdot 10^{-01}$	$7.077 \cdot 10^{-02}$	$1.150 \cdot 10^{-01}$	$1.082 \cdot 10^{-01}$	$\mathbf{1.471 \cdot 10^{-02}}$	$3.775 \cdot 10^{-01}$	$3.959 \cdot 10^{-01}$	$1.282 \cdot 10^{-01}$	$1.101 \cdot 10^{+00}$	$8.103 \cdot 10^{-01}$	$3.319 \cdot 10^{-01}$
y	0.10	+1	$1.889 \cdot 10^{-01}$	$6.448 \cdot 10^{-01}$	$8.458 \cdot 10^{-01}$	$1.221 \cdot 10^{-01}$	$1.087 \cdot 10^{-01}$	$\mathbf{1.708 \cdot 10^{-02}}$	$9.471 \cdot 10^{-01}$	$2.691 \cdot 10^{-01}$	$7.866 \cdot 10^{-01}$	$1.153 \cdot 10^{+00}$	$7.341 \cdot 10^{-01}$	$1.011 \cdot 10^{+00}$
y	0.15	−1	$3.404 \cdot 10^{-01}$	$1.423 \cdot 10^{-01}$	$8.131 \cdot 10^{-01}$	$9.683 \cdot 10^{-02}$	$1.245 \cdot 10^{-01}$	$\mathbf{2.182 \cdot 10^{-02}}$	$5.820 \cdot 10^{-01}$	$3.493 \cdot 10^{-01}$	$1.541 \cdot 10^{-01}$	$1.099 \cdot 10^{+00}$	$8.208 \cdot 10^{-01}$	$1.230 \cdot 10^{+00}$
y	0.15	+1	$2.423 \cdot 10^{-01}$	$7.064 \cdot 10^{-02}$	$7.418 \cdot 10^{-02}$	$1.382 \cdot 10^{-01}$	$1.350 \cdot 10^{-01}$	$\mathbf{2.437 \cdot 10^{-02}}$	$7.929 \cdot 10^{-01}$	$2.882 \cdot 10^{-01}$	$7.360 \cdot 10^{-01}$	$8.896 \cdot 10^{-01}$	$8.913 \cdot 10^{-01}$	$8.411 \cdot 10^{-01}$
z	0.05	−1	$7.220 \cdot 10^{-01}$	$1.245 \cdot 10^{+00}$	$2.361 \cdot 10^{-01}$	$1.174 \cdot 10^{-01}$	$6.207 \cdot 10^{-01}$	$\mathbf{7.383 \cdot 10^{-03}}$	$8.867 \cdot 10^{-01}$	$8.704 \cdot 10^{-01}$	$1.368 \cdot 10^{-01}$	$1.023 \cdot 10^{+00}$	$9.352 \cdot 10^{-01}$	$2.777 \cdot 10^{-02}$
z	0.05	+1	$1.154 \cdot 10^{-01}$	$5.698 \cdot 10^{-02}$	$7.341 \cdot 10^{-02}$	$1.716 \cdot 10^{-01}$	$1.555 \cdot 10^{-01}$	$\mathbf{9.118 \cdot 10^{-03}}$	$1.149 \cdot 10^{+00}$	$2.980 \cdot 10^{-01}$	$1.683 \cdot 10^{-01}$	$9.263 \cdot 10^{-01}$	$5.040 \cdot 10^{-01}$	$2.594 \cdot 10^{-02}$
z	0.10	−1	$8.884 \cdot 10^{-01}$	$9.622 \cdot 10^{-02}$	$1.008 \cdot 10^{-01}$	$6.645 \cdot 10^{-02}$	$2.732 \cdot 10^{-02}$	$\mathbf{7.727 \cdot 10^{-03}}$	$1.033 \cdot 10^{+00}$	$1.784 \cdot 10^{-01}$	$2.755 \cdot 10^{-01}$	$1.119 \cdot 10^{+00}$	$7.502 \cdot 10^{-01}$	$2.189 \cdot 10^{-02}$
z	0.10	+1	$1.418 \cdot 10^{-01}$	$1.110 \cdot 10^{-01}$	$4.371 \cdot 10^{-01}$	$1.479 \cdot 10^{-01}$	$1.249 \cdot 10^{+00}$	$\mathbf{1.015 \cdot 10^{-02}}$	$5.276 \cdot 10^{-01}$	$3.107 \cdot 10^{-01}$	$2.265 \cdot 10^{-01}$	$9.111 \cdot 10^{-01}$	$1.006 \cdot 10^{+00}$	$8.902 \cdot 10^{-01}$
z	0.15	−1	$5.964 \cdot 10^{-01}$	$9.698 \cdot 10^{-01}$	$1.293 \cdot 10^{-01}$	$2.053 \cdot 10^{-01}$	$1.675 \cdot 10^{-02}$	$\mathbf{1.321 \cdot 10^{-02}}$	$8.112 \cdot 10^{-01}$	$7.586 \cdot 10^{-01}$	$6.165 \cdot 10^{-01}$	$1.220 \cdot 10^{+00}$	$1.073 \cdot 10^{+00}$	$1.444 \cdot 10^{-01}$
z	0.15	+1	$1.835 \cdot 10^{-01}$	$2.166 \cdot 10^{-01}$	$1.330 \cdot 10^{+00}$	$9.292 \cdot 10^{-02}$	$1.164 \cdot 10^{+00}$	$\mathbf{1.208 \cdot 10^{-02}}$	$6.076 \cdot 10^{-01}$	$9.289 \cdot 10^{-01}$	$2.905 \cdot 10^{-01}$	$9.935 \cdot 10^{-01}$	$1.131 \cdot 10^{+00}$	$1.011 \cdot 10^{+00}$

Table 2: Positional error: Average error is computed for the last 300 nodes, i.e. for the last 0.6 s of the trajectory. We used a factor of 2 for the integration time, i.e. the integration constant is 0.004 s with a real-time control frequency of 250 Hz. Bold types of minimum values are considered experiment (i.e. row) wise.

direction	radius	orientation	5-standard	10-standard	20-standard	5-standard-angled	10-standard-angled	20-standard-angled	5-rotated	10-rotated	20-rotated	5-human	10-human	20-human
x	0.05	−1	$1.974 \cdot 10^{-01}$	$1.277 \cdot 10^{+00}$	$1.014 \cdot 10^{+00}$	$3.028 \cdot 10^{-02}$	$1.701 \cdot 10^{-02}$	$1.716 \cdot 10^{-02}$	$9.874 \cdot 10^{-02}$	$7.408 \cdot 10^{-02}$	$1.091 \cdot 10^{-02}$	$1.184 \cdot 10^{+00}$	$\mathbf{6.631 \cdot 10^{-03}}$	$5.792 \cdot 10^{-02}$
x	0.05	+1	$5.752 \cdot 10^{-01}$	$1.123 \cdot 10^{+00}$	$1.481 \cdot 10^{+00}$	$3.035 \cdot 10^{-02}$	$1.419 \cdot 10^{-02}$	$1.681 \cdot 10^{-02}$	$1.064 \cdot 10^{-01}$	$9.886 \cdot 10^{-03}$	$1.087 \cdot 10^{-02}$	$1.284 \cdot 10^{+00}$	$5.320 \cdot 10^{-02}$	$\mathbf{4.127 \cdot 10^{-03}}$
x	0.10	−1	$1.428 \cdot 10^{-01}$	$1.917 \cdot 10^{+00}$	$1.882 \cdot 10^{+00}$	$3.323 \cdot 10^{-02}$	$1.478 \cdot 10^{-02}$	$3.431 \cdot 10^{-02}$	$1.238 \cdot 10^{-01}$	$5.162 \cdot 10^{-02}$	$\mathbf{1.455 \cdot 10^{-02}}$	$6.900 \cdot 10^{-01}$	$2.438 \cdot 10^{-02}$	$8.851 \cdot 10^{-02}$
x	0.10	+1	$1.206 \cdot 10^{+00}$	$1.061 \cdot 10^{+00}$	$1.507 \cdot 10^{+00}$	$7.163 \cdot 10^{-02}$	$1.387 \cdot 10^{-02}$	$3.326 \cdot 10^{-02}$	$7.506 \cdot 10^{-02}$	$\mathbf{7.038 \cdot 10^{-03}}$	$1.491 \cdot 10^{-02}$	$1.143 \cdot 10^{+00}$	$7.959 \cdot 10^{-02}$	$3.365 \cdot 10^{-02}$
x	0.15	−1	$1.537 \cdot 10^{+00}$	$6.119 \cdot 10^{-01}$	$1.189 \cdot 10^{+00}$	$7.546 \cdot 10^{-02}$	$2.132 \cdot 10^{-02}$	$5.111 \cdot 10^{-02}$	$1.014 \cdot 10^{-01}$	$1.110 \cdot 10^{-01}$	$\mathbf{1.876 \cdot 10^{-02}}$	$9.160 \cdot 10^{-01}$	$5.192 \cdot 10^{-02}$	$6.193 \cdot 10^{-01}$
x	0.15	+1	$2.178 \cdot 10^{-01}$	$7.850 \cdot 10^{-01}$	$1.397 \cdot 10^{+00}$	$8.376 \cdot 10^{-02}$	$\mathbf{1.924 \cdot 10^{-02}}$	$4.922 \cdot 10^{-02}$	$6.905 \cdot 10^{-02}$	$2.872 \cdot 10^{-02}$	$1.975 \cdot 10^{-02}$	$1.064 \cdot 10^{+00}$	$1.034 \cdot 10^{-01}$	$6.193 \cdot 10^{-01}$
y	0.05	−1	$1.167 \cdot 10^{-01}$	$4.747 \cdot 10^{-01}$	$1.584 \cdot 10^{-01}$	$2.767 \cdot 10^{-02}$	$1.709 \cdot 10^{-02}$	$1.709 \cdot 10^{-02}$	$5.905 \cdot 10^{-02}$	$3.302 \cdot 10^{-02}$	$\mathbf{5.167 \cdot 10^{-03}}$	$9.463 \cdot 10^{-01}$	$1.859 \cdot 10^{-02}$	$2.990 \cdot 10^{-02}$
y	0.05	+1	$3.727 \cdot 10^{-02}$	$6.235 \cdot 10^{-01}$	$2.332 \cdot 10^{-01}$	$3.444 \cdot 10^{-02}$	$1.571 \cdot 10^{-02}$	$1.748 \cdot 10^{-02}$	$1.206 \cdot 10^{-01}$	$3.183 \cdot 10^{-01}$	$\mathbf{1.297 \cdot 10^{-02}}$	$1.202 \cdot 10^{+00}$	$2.020 \cdot 10^{-02}$	$5.047 \cdot 10^{-02}$
y	0.10	−1	$1.755 \cdot 10^{-01}$	$1.121 \cdot 10^{+00}$	$6.182 \cdot 10^{-01}$	$7.764 \cdot 10^{-02}$	$1.534 \cdot 10^{-02}$	$3.432 \cdot 10^{-02}$	$8.481 \cdot 10^{-02}$	$4.569 \cdot 10^{-02}$	$\mathbf{4.539 \cdot 10^{-03}}$	$1.169 \cdot 10^{+00}$	$8.378 \cdot 10^{-01}$	$1.307 \cdot 10^{-01}$
y	0.10	+1	$3.159 \cdot 10^{-01}$	$1.685 \cdot 10^{-01}$	$1.401 \cdot 10^{+00}$	$4.422 \cdot 10^{-02}$	$1.675 \cdot 10^{-02}$	$3.474 \cdot 10^{-02}$	$5.785 \cdot 10^{-02}$	$3.303 \cdot 10^{-02}$	$\mathbf{1.536 \cdot 10^{-02}}$	$8.548 \cdot 10^{-01}$	$1.073 \cdot 10^{+00}$	$9.540 \cdot 10^{-01}$
y	0.15	−1	$7.905 \cdot 10^{-02}$	$1.342 \cdot 10^{+00}$	$1.490 \cdot 10^{+00}$	$7.027 \cdot 10^{-02}$	$2.141 \cdot 10^{-02}$	$5.143 \cdot 10^{-02}$	$9.034 \cdot 10^{-02}$	$5.310 \cdot 10^{-02}$	$\mathbf{7.752 \cdot 10^{-03}}$	$1.230 \cdot 10^{+00}$	$9.175 \cdot 10^{-01}$	$1.919 \cdot 10^{-01}$
y	0.15	+1	$4.400 \cdot 10^{-02}$	$1.644 \cdot 10^{-01}$	$1.399 \cdot 10^{+00}$	$6.027 \cdot 10^{-02}$	$1.849 \cdot 10^{-02}$	$4.706 \cdot 10^{-02}$	$1.151 \cdot 10^{-01}$	$4.107 \cdot 10^{-01}$	$\mathbf{1.865 \cdot 10^{-02}}$	$9.268 \cdot 10^{-01}$	$8.908 \cdot 10^{-01}$	$2.251 \cdot 10^{-01}$
z	0.05	−1	$1.034 \cdot 10^{+00}$	$2.832 \cdot 10^{-02}$	$1.355 \cdot 10^{-03}$	$5.359 \cdot 10^{-02}$	$1.264 \cdot 10^{-02}$	$\mathbf{2.149 \cdot 10^{-04}}$	$1.408 \cdot 10^{-01}$	$3.359 \cdot 10^{-02}$	$3.230 \cdot 10^{-04}$	$6.483 \cdot 10^{-01}$	$1.016 \cdot 10^{+00}$	$1.333 \cdot 10^{-02}$
z	0.05	+1	$6.236 \cdot 10^{-01}$	$1.170 \cdot 10^{+00}$	$7.866 \cdot 10^{-01}$	$3.233 \cdot 10^{-02}$	$1.159 \cdot 10^{-02}$	$\mathbf{1.796 \cdot 10^{-04}}$	$5.032 \cdot 10^{-02}$	$6.899 \cdot 10^{-02}$	$1.728 \cdot 10^{-02}$	$9.816 \cdot 10^{-01}$	$2.967 \cdot 10^{-02}$	$3.667 \cdot 10^{-02}$
z	0.10	−1	$2.580 \cdot 10^{-01}$	$1.170 \cdot 10^{-01}$	$6.384 \cdot 10^{-04}$	$3.030 \cdot 10^{-02}$	$9.933 \cdot 10^{-03}$	$\mathbf{2.177 \cdot 10^{-04}}$	$4.148 \cdot 10^{-01}$	$6.974 \cdot 10^{-02}$	$9.125 \cdot 10^{-03}$	$1.212 \cdot 10^{+00}$	$1.123 \cdot 10^{+00}$	$3.677 \cdot 10^{-03}$
z	0.10	+1	$1.044 \cdot 10^{-01}$	$1.008 \cdot 10^{+00}$	$1.003 \cdot 10^{-01}$	$9.753 \cdot 10^{-02}$	$1.687 \cdot 10^{-02}$	$\mathbf{2.565 \cdot 10^{-04}}$	$2.451 \cdot 10^{-01}$	$1.849 \cdot 10^{-01}$	$2.493 \cdot 10^{-02}$	$7.314 \cdot 10^{-01}$	$8.636 \cdot 10^{-01}$	$5.092 \cdot 10^{-02}$
z	0.15	−1	$3.561 \cdot 10^{-02}$	$1.678 \cdot 10^{-01}$	$5.891 \cdot 10^{-01}$	$1.841 \cdot 10^{-02}$	$2.087 \cdot 10^{-02}$	$\mathbf{1.448 \cdot 10^{-03}}$	$5.791 \cdot 10^{-01}$	$2.323 \cdot 10^{-01}$	$1.810 \cdot 10^{-02}$	$1.241 \cdot 10^{+00}$	$8.320 \cdot 10^{-01}$	$6.646 \cdot 10^{-01}$
z	0.15	+1	$1.989 \cdot 10^{-01}$	$1.632 \cdot 10^{+00}$	$1.472 \cdot 10^{-01}$	$7.473 \cdot 10^{-02}$	$1.260 \cdot 10^{-02}$	$\mathbf{5.647 \cdot 10^{-04}}$	$5.753 \cdot 10^{-01}$	$1.707 \cdot 10^{-01}$	$2.916 \cdot 10^{-02}$	$1.031 \cdot 10^{+00}$	$9.651 \cdot 10^{-01}$	$3.289 \cdot 10^{-01}$

Table 3: Positional error: Average error is computed for the last 300 nodes, i.e. for the last 0.6 s of the trajectory. We used a factor of 4 for the integration time, i.e. the integration constant is 0.008 s with a real-time control frequency of 125 Hz. Bold types of minimum values are considered experiment (i.e. row) wise.

direction	radius	orientation	5-standard	10-standard	20-standard	5-standard-angled	10-standard-angled	20-standard-angled	5-rotated	10-rotated	20-rotated	5-human	10-human	20-human
x	0.05	−1	$1.070 \cdot 10^{+00}$	$1.152 \cdot 10^{+00}$	$1.949 \cdot 10^{+00}$	$\mathbf{1.218 \cdot 10^{-02}}$	$1.571 \cdot 10^{-02}$	$4.248 \cdot 10^{-02}$	$2.233 \cdot 10^{-02}$	$1.271 \cdot 10^{-02}$	$2.548 \cdot 10^{-02}$	$2.085 \cdot 10^{-02}$	$5.745 \cdot 10^{-02}$	$4.598 \cdot 10^{-02}$
x	0.05	+1	$8.846 \cdot 10^{-02}$	$1.105 \cdot 10^{-01}$	$1.383 \cdot 10^{+00}$	$1.095 \cdot 10^{-02}$	$1.539 \cdot 10^{-02}$	$4.317 \cdot 10^{-02}$	$1.768 \cdot 10^{-02}$	$1.269 \cdot 10^{-02}$	$7.272 \cdot 10^{-02}$	$2.344 \cdot 10^{-02}$	$\mathbf{3.201 \cdot 10^{-03}}$	$4.359 \cdot 10^{-02}$
x	0.10	−1	$5.861 \cdot 10^{-02}$	$1.024 \cdot 10^{+00}$	$1.083 \cdot 10^{+00}$	$1.411 \cdot 10^{-02}$	$3.137 \cdot 10^{-02}$	$8.225 \cdot 10^{-02}$	$1.539 \cdot 10^{-02}$	$1.732 \cdot 10^{-02}$	$4.937 \cdot 10^{-02}$	$\mathbf{9.145 \cdot 10^{-03}}$	$8.691 \cdot 10^{-02}$	$5.559 \cdot 10^{-02}$
x	0.10	+1	$1.199 \cdot 10^{+00}$	$1.339 \cdot 10^{+00}$	$1.934 \cdot 10^{+00}$	$\mathbf{1.335 \cdot 10^{-02}}$	$3.025 \cdot 10^{-02}$	$8.910 \cdot 10^{-02}$	$3.018 \cdot 10^{-02}$	$1.762 \cdot 10^{-02}$	$4.517 \cdot 10^{-02}$	$9.367 \cdot 10^{-02}$	$3.127 \cdot 10^{-02}$	$9.237 \cdot 10^{-02}$
x	0.15	−1	$7.613 \cdot 10^{-01}$	$1.623 \cdot 10^{+00}$	$1.120 \cdot 10^{+00}$	$1.957 \cdot 10^{-02}$	$4.663 \cdot 10^{-02}$	$1.209 \cdot 10^{-01}$	$4.637 \cdot 10^{-02}$	$2.228 \cdot 10^{-02}$	$7.334 \cdot 10^{-02}$	$3.217 \cdot 10^{-02}$	$1.170 \cdot 10^{-01}$	$\mathbf{1.554 \cdot 10^{-03}}$
x	0.15	+1	$7.850 \cdot 10^{-01}$	$1.357 \cdot 10^{+00}$	$6.938 \cdot 10^{-01}$	$\mathbf{1.764 \cdot 10^{-02}}$	$4.467 \cdot 10^{-02}$	$1.292 \cdot 10^{-01}$	$4.298 \cdot 10^{-02}$	$2.361 \cdot 10^{-02}$	$6.922 \cdot 10^{-02}$	$1.285 \cdot 10^{-01}$	$5.937 \cdot 10^{-02}$	$1.448 \cdot 10^{-01}$
y	0.05	−1	$6.510 \cdot 10^{-01}$	$1.297 \cdot 10^{+00}$	$3.499 \cdot 10^{-01}$	$1.293 \cdot 10^{-02}$	$1.549 \cdot 10^{-02}$	$4.269 \cdot 10^{-02}$	$5.386 \cdot 10^{-03}$	$5.750 \cdot 10^{-03}$	$3.159 \cdot 10^{-02}$	$3.840 \cdot 10^{-02}$	$3.154 \cdot 10^{-02}$	$\mathbf{2.430 \cdot 10^{-03}}$
y	0.05	+1	$7.354 \cdot 10^{-02}$	$6.217 \cdot 10^{-01}$	$6.868 \cdot 10^{-01}$	$1.264 \cdot 10^{-02}$	$1.584 \cdot 10^{-02}$	$1.201 \cdot 10^{-01}$	$2.385 \cdot 10^{-02}$	$1.502 \cdot 10^{-02}$	$1.739 \cdot 10^{-02}$	$2.603 \cdot 10^{-02}$	$5.431 \cdot 10^{-02}$	$\mathbf{2.549 \cdot 10^{-03}}$
y	0.10	−1	$6.892 \cdot 10^{-02}$	$1.263 \cdot 10^{+00}$	$1.327 \cdot 10^{+00}$	$1.452 \cdot 10^{-02}$	$3.115 \cdot 10^{-02}$	$8.520 \cdot 10^{-02}$	$1.944 \cdot 10^{-02}$	$\mathbf{4.421 \cdot 10^{-03}}$	$5.543 \cdot 10^{-02}$	$9.538 \cdot 10^{-01}$	$1.195 \cdot 10^{-01}$	$1.270 \cdot 10^{-02}$
y	0.10	+1	$1.051 \cdot 10^{-01}$	$1.723 \cdot 10^{+00}$	$1.778 \cdot 10^{+00}$	$1.522 \cdot 10^{-02}$	$1.753 \cdot 10^{-02}$	$1.163 \cdot 10^{-01}$	$3.540 \cdot 10^{-02}$	$1.975 \cdot 10^{-02}$	$4.186 \cdot 10^{-02}$	$6.645 \cdot 10^{-01}$	$1.097 \cdot 10^{-01}$	$\mathbf{1.314 \cdot 10^{-02}}$
y	0.15	−1	$8.638 \cdot 10^{-01}$	$1.334 \cdot 10^{+00}$	$6.878 \cdot 10^{-01}$	$1.928 \cdot 10^{-02}$	$4.669 \cdot 10^{-02}$	$7.913 \cdot 10^{-01}$	$3.048 \cdot 10^{-02}$	$\mathbf{8.067 \cdot 10^{-03}}$	$5.731 \cdot 10^{-02}$	$1.196 \cdot 10^{+00}$	$7.185 \cdot 10^{-01}$	$1.007 \cdot 10^{+00}$
y	0.15	+1	$5.483 \cdot 10^{-02}$	$7.341 \cdot 10^{-01}$	$1.787 \cdot 10^{+00}$	$\mathbf{2.123 \cdot 10^{-02}}$	$6.374 \cdot 10^{-02}$	$1.244 \cdot 10^{-01}$	$4.879 \cdot 10^{-02}$	$2.397 \cdot 10^{-02}$	$6.601 \cdot 10^{-02}$	$1.082 \cdot 10^{+00}$	$2.022 \cdot 10^{-01}$	$2.528 \cdot 10^{-02}$
z	0.05	−1	$6.277 \cdot 10^{-02}$	$1.537 \cdot 10^{-03}$	$4.169 \cdot 10^{-01}$	$7.764 \cdot 10^{-03}$	$\mathbf{3.087 \cdot 10^{-04}}$	$7.375 \cdot 10^{-02}$	$1.275 \cdot 10^{-02}$	$7.208 \cdot 10^{-04}$	$1.052 \cdot 10^{-03}$	$1.119 \cdot 10^{+00}$	$1.322 \cdot 10^{-02}$	$3.252 \cdot 10^{-03}$
z	0.05	+1	$9.079 \cdot 10^{-02}$	$6.966 \cdot 10^{-02}$	$5.193 \cdot 10^{-02}$	$\mathbf{3.616 \cdot 10^{-04}}$	$1.013 \cdot 10^{-02}$	$4.275 \cdot 10^{-04}$	$7.013 \cdot 10^{-02}$	$4.570 \cdot 10^{-02}$	$8.975 \cdot 10^{-03}$	$1.150 \cdot 10^{-01}$	$1.098 \cdot 10^{-02}$	$8.065 \cdot 10^{-03}$
z	0.10	−1	$8.806 \cdot 10^{-02}$	$6.924 \cdot 10^{-01}$	$9.878 \cdot 10^{-02}$	$\mathbf{3.237 \cdot 10^{-04}}$	$1.045 \cdot 10^{-02}$	$4.275 \cdot 10^{-04}$	$7.013 \cdot 10^{-01}$	$4.570 \cdot 10^{-01}$	$8.975 \cdot 10^{-03}$	$1.701 \cdot 10^{-01}$	$1.904 \cdot 10^{-01}$	$8.582 \cdot 10^{-02}$
z	0.10	+1	$1.323 \cdot 10^{-01}$	$1.091 \cdot 10^{-01}$	$9.878 \cdot 10^{-02}$	$\mathbf{5.611 \cdot 10^{-04}}$	$1.045 \cdot 10^{-02}$	$8.870 \cdot 10^{-04}$	$2.675 \cdot 10^{-02}$	$2.606 \cdot 10^{-02}$	$1.701 \cdot 10^{-01}$	$1.904 \cdot 10^{-01}$	$8.582 \cdot 10^{-01}$	$3.612 \cdot 10^{-03}$
z	0.15	−1	$9.608 \cdot 10^{-01}$	$2.347 \cdot 10^{-01}$	$1.198 \cdot 10^{-03}$	$3.466 \cdot 10^{-02}$	$1.871 \cdot 10^{-03}$	$\mathbf{7.320 \cdot 10^{-04}}$	$1.012 \cdot 10^{-01}$	$1.766 \cdot 10^{-02}$	$9.801 \cdot 10^{-03}$	$9.135 \cdot 10^{-01}$	$5.019 \cdot 10^{-02}$	$1.280 \cdot 10^{-02}$
z	0.15	+1	$1.481 \cdot 10^{+00}$	$9.179 \cdot 10^{-01}$	$2.440 \cdot 10^{-01}$	$1.381 \cdot 10^{-02}$	$\mathbf{6.822 \cdot 10^{-04}}$	$1.148 \cdot 10^{-02}$	$6.769 \cdot 10^{-02}$	$3.089 \cdot 10^{-02}$	$2.080 \cdot 10^{-01}$	$2.470 \cdot 10^{-01}$	$1.819 \cdot 10^{-01}$	$6.706 \cdot 10^{-02}$

Table 4: Rotational error: Average error is computed for the last 300 nodes, i.e. for the last 0.6 s of the trajectory. We used a factor of 1 for the integration time, i.e. the integration constant is 0.002 s with a real-time control frequency of 500 Hz. Bold types of minimum values are considered experiment (i.e. row) wise.

direction	radius	orientation	5-standard	10-standard	20-standard	5-standard-angled	10-standard-angled	20-standard-angled	5-rotated	10-rotated	20-rotated	5-human	10-human	20-human
x	0.05	−1	$1.247 \cdot 10^{+01}$	$1.310 \cdot 10^{-01}$	$7.373 \cdot 10^{+01}$	$7.542 \cdot 10^{-02}$	$2.769 \cdot 10^{-02}$	$\mathbf{3.450 \cdot 10^{-03}}$	$7.981 \cdot 10^{+01}$	$1.369 \cdot 10^{-01}$	$2.606 \cdot 10^{-02}$	$9.172 \cdot 10^{+01}$	$1.157 \cdot 10^{+02}$	$3.073 \cdot 10^{-02}$
x	0.05	+1	$5.951 \cdot 10^{-01}$	$6.783 \cdot 10^{-01}$	$5.377 \cdot 10^{+01}$	$6.791 \cdot 10^{-02}$	$2.377 \cdot 10^{-02}$	$\mathbf{6.241 \cdot 10^{-03}}$	$2.513 \cdot 10^{+01}$	$6.013 \cdot 10^{-01}$	$2.775 \cdot 10^{-02}$	$7.656 \cdot 10^{+01}$	$1.019 \cdot 10^{+02}$	$1.515 \cdot 10^{-02}$
x	0.10	−1	$3.482 \cdot 10^{+00}$	$6.476 \cdot 10^{+01}$	$8.437 \cdot 10^{+01}$	$7.479 \cdot 10^{-02}$	$2.646 \cdot 10^{-02}$	$\mathbf{8.523 \cdot 10^{-03}}$	$8.139 \cdot 10^{+01}$	$1.306 \cdot 10^{-01}$	$2.375 \cdot 10^{-02}$	$9.971 \cdot 10^{+01}$	$9.207 \cdot 10^{+01}$	$4.861 \cdot 10^{-02}$
x	0.10	+1	$2.454 \cdot 10^{-01}$	$6.570 \cdot 10^{+01}$	$9.276 \cdot 10^{+01}$	$5.971 \cdot 10^{-02}$	$2.478 \cdot 10^{-02}$	$\mathbf{8.036 \cdot 10^{-03}}$	$8.697 \cdot 10^{+01}$	$7.278 \cdot 10^{+01}$	$3.468 \cdot 10^{-02}$	$9.862 \cdot 10^{+01}$	$8.531 \cdot 10^{+01}$	$5.313 \cdot 10^{-02}$
x	0.15	−1	$8.232 \cdot 10^{+00}$	$7.792 \cdot 10^{-01}$	$9.291 \cdot 10^{+01}$	$7.739 \cdot 10^{-02}$	$2.865 \cdot 10^{-02}$	$\mathbf{1.482 \cdot 10^{-02}}$	$8.198 \cdot 10^{+01}$	$6.460 \cdot 10^{-01}$	$3.004 \cdot 10^{-02}$	$8.531 \cdot 10^{+01}$	$8.752 \cdot 10^{+01}$	$6.124 \cdot 10^{-02}$
x	0.15	+1	$8.690 \cdot 10^{-01}$	$1.161 \cdot 10^{+02}$	$7.792 \cdot 10^{-01}$	$5.669 \cdot 10^{-02}$	$2.258 \cdot 10^{-02}$	$\mathbf{1.153 \cdot 10^{-02}}$	$6.804 \cdot 10^{+01}$	$2.026 \cdot 10^{-01}$	$3.052 \cdot 10^{-02}$	$9.513 \cdot 10^{+01}$	$9.827 \cdot 10^{+01}$	$6.627 \cdot 10^{-02}$
y	0.05	−1	$1.421 \cdot 10^{+00}$	$2.530 \cdot 10^{-01}$	$6.057 \cdot 10^{-02}$	$6.166 \cdot 10^{-02}$	$3.486 \cdot 10^{-02}$	$\mathbf{8.255 \cdot 10^{-03}}$	$9.971 \cdot 10^{+01}$	$1.751 \cdot 10^{-01}$	$3.203 \cdot 10^{-02}$	$9.346 \cdot 10^{+01}$	$9.021 \cdot 10^{+01}$	$1.615 \cdot 10^{-02}$
y	0.05	+1	$1.572 \cdot 10^{+00}$	$1.384 \cdot 10^{-02}$	$1.152 \cdot 10^{+01}$	$5.819 \cdot 10^{-02}$	$2.312 \cdot 10^{-02}$	$\mathbf{4.126 \cdot 10^{-03}}$	$9.418 \cdot 10^{+01}$	$1.097 \cdot 10^{+00}$	$2.880 \cdot 10^{-02}$	$8.003 \cdot 10^{+01}$	$7.953 \cdot 10^{+01}$	$3.157 \cdot 10^{-02}$
y	0.10	−1	$7.281 \cdot 10^{+00}$	$2.146 \cdot 10^{-02}$	$6.693 \cdot 10^{+01}$	$8.447 \cdot 10^{-02}$	$4.985 \cdot 10^{-02}$	$\mathbf{6.300 \cdot 10^{-03}}$	$1.283 \cdot 10^{-01}$	$2.070 \cdot 10^{-01}$	$3.333 \cdot 10^{-02}$	$9.269 \cdot 10^{+01}$	$9.430 \cdot 10^{+01}$	$1.146 \cdot 10^{-01}$
y	0.10	+1	$9.132 \cdot 10^{-01}$	$1.701 \cdot 10^{+01}$	$1.092 \cdot 10^{-01}$	$6.097 \cdot 10^{-02}$	$3.286 \cdot 10^{-02}$	$\mathbf{5.401 \cdot 10^{-03}}$	$8.375 \cdot 10^{+01}$	$2.351 \cdot 10^{-01}$	$2.460 \cdot 10^{-02}$	$8.267 \cdot 10^{+01}$	$9.215 \cdot 10^{+01}$	$8.773 \cdot 10^{+01}$
y	0.15	−1	$6.867 \cdot 10^{+00}$	$2.891 \cdot 10^{-01}$	$7.014 \cdot 10^{+01}$	$8.256 \cdot 10^{-02}$	$7.887 \cdot 10^{-02}$	$\mathbf{1.028 \cdot 10^{-02}}$	$9.096 \cdot 10^{+01}$	$1.021 \cdot 10^{-01}$	$3.226 \cdot 10^{-02}$	$8.904 \cdot 10^{+01}$	$8.752 \cdot 10^{+01}$	$9.723 \cdot 10^{-01}$
y	0.15	+1	$8.007 \cdot 10^{+01}$	$6.613 \cdot 10^{-01}$	$1.221 \cdot 10^{-01}$	$7.090 \cdot 10^{-02}$	$7.803 \cdot 10^{-02}$	$\mathbf{4.072 \cdot 10^{-03}}$	$8.340 \cdot 10^{+01}$	$1.212 \cdot 10^{-01}$	$2.916 \cdot 10^{-02}$	$8.904 \cdot 10^{+01}$	$8.752 \cdot 10^{+01}$	$8.287 \cdot 10^{+01}$
z	0.05	−1	$5.779 \cdot 10^{+00}$	$7.781 \cdot 10^{+01}$	$1.452 \cdot 10^{+01}$	$1.296 \cdot 10^{-02}$	$1.361 \cdot 10^{-02}$	$\mathbf{1.766 \cdot 10^{-03}}$	$7.705 \cdot 10^{+01}$	$3.771 \cdot 10^{-01}$	$4.416 \cdot 10^{-02}$	$1.009 \cdot 10^{+02}$	$9.222 \cdot 10^{+01}$	$1.741 \cdot 10^{-02}$
z	0.05	+1	$5.652 \cdot 10^{-01}$	$2.925 \cdot 10^{-02}$	$2.062 \cdot 10^{-02}$	$4.034 \cdot 10^{-02}$	$3.429 \cdot 10^{-02}$	$\mathbf{1.724 \cdot 10^{-03}}$	$4.086 \cdot 10^{+01}$	$3.746 \cdot 10^{-02}$	$4.846 \cdot 10^{-02}$	$8.696 \cdot 10^{+01}$	$8.352 \cdot 10^{+01}$	$3.209 \cdot 10^{-02}$
z	0.10	−1	$6.310 \cdot 10^{-01}$	$1.708 \cdot 10^{-02}$	$1.290 \cdot 10^{-01}$	$8.846 \cdot 10^{-03}$	$5.841 \cdot 10^{-03}$	$\mathbf{1.155 \cdot 10^{-03}}$	$8.703 \cdot 10^{+01}$	$2.796 \cdot 10^{-01}$	$1.003 \cdot 10^{-01}$	$7.944 \cdot 10^{+01}$	$8.776 \cdot 10^{+01}$	$3.288 \cdot 10^{-02}$
z	0.10	+1	$6.037 \cdot 10^{-01}$	$1.490 \cdot 10^{-02}$	$5.974 \cdot 10^{+00}$	$2.652 \cdot 10^{-02}$	$6.375 \cdot 10^{-02}$	$\mathbf{1.342 \cdot 10^{-03}}$	$2.660 \cdot 10^{-01}$	$1.910 \cdot 10^{-01}$	$5.312 \cdot 10^{-02}$	$9.750 \cdot 10^{+01}$	$8.892 \cdot 10^{+01}$	$8.370 \cdot 10^{+01}$
z	0.15	−1	$5.377 \cdot 10^{-01}$	$1.227 \cdot 10^{+01}$	$1.654 \cdot 10^{-01}$	$5.482 \cdot 10^{-03}$	$\mathbf{4.093 \cdot 10^{-03}}$	$7.042 \cdot 10^{-01}$	$8.062 \cdot 10^{+01}$	$5.896 \cdot 10^{-01}$	$2.537 \cdot 10^{-01}$	$8.172 \cdot 10^{+01}$	$8.982 \cdot 10^{+01}$	$1.458 \cdot 10^{+00}$
z	0.15	+1	$9.076 \cdot 10^{-01}$	$3.110 \cdot 10^{-02}$	$7.260 \cdot 10^{+01}$	$3.736 \cdot 10^{-02}$	$7.913 \cdot 10^{+01}$	$\mathbf{3.560 \cdot 10^{-03}}$	$8.938 \cdot 10^{+01}$	$9.892 \cdot 10^{+01}$	$6.810 \cdot 10^{-02}$	$8.527 \cdot 10^{+01}$	$9.360 \cdot 10^{+01}$	$9.269 \cdot 10^{+01}$

Table 5: Rotational error: Average error is computed for the last 300 nodes, i.e. for the last 0.6 s of the trajectory. We used a factor of 2 for the integration time, i.e. the integration constant is 0.004 s with a real-time control frequency of 250 Hz. Bold types of minimum values are considered experiment (i.e. row) wise.

direction	radius	orientation	5-standard	10-standard	20-standard	5-standard-angled	10-standard-angled	20-standard-angled	5-rotated	10-rotated	20-rotated	5-human	10-human	20-human
x	0.05	−1	$3.297 \cdot 10^{-01}$	$7.560 \cdot 10^{+01}$	$7.050 \cdot 10^{+01}$	$1.218 \cdot 10^{-02}$	$4.860 \cdot 10^{-03}$	$1.247 \cdot 10^{-02}$	$8.083 \cdot 10^{-02}$	$4.775 \cdot 10^{-02}$	$\mathbf{4.381 \cdot 10^{-03}}$	$7.681 \cdot 10^{+01}$	$3.096 \cdot 10^{-02}$	$5.075 \cdot 10^{-02}$
x	0.05	+1	$5.188 \cdot 10^{+00}$	$7.126 \cdot 10^{+01}$	$7.176 \cdot 10^{+01}$	$1.586 \cdot 10^{-02}$	$\mathbf{3.613 \cdot 10^{-03}}$	$1.147 \cdot 10^{-02}$	$9.745 \cdot 10^{-02}$	$1.476 \cdot 10^{-02}$	$5.501 \cdot 10^{-03}$	$9.156 \cdot 10^{+01}$	$2.089 \cdot 10^{-02}$	$1.649 \cdot 10^{-02}$
x	0.10	−1	$3.722 \cdot 10^{-01}$	$9.245 \cdot 10^{+01}$	$8.268 \cdot 10^{+01}$	$1.946 \cdot 10^{-02}$	$7.361 \cdot 10^{-02}$	$2.334 \cdot 10^{-02}$	$7.780 \cdot 10^{-02}$	$\mathbf{5.635 \cdot 10^{-03}}$	$8.603 \cdot 10^{+01}$	$5.244 \cdot 10^{-02}$	$8.370 \cdot 10^{-02}$	
x	0.10	+1	$6.778 \cdot 10^{-01}$	$5.517 \cdot 10^{+01}$	$7.072 \cdot 10^{+01}$	$2.373 \cdot 10^{-02}$	$\mathbf{6.091 \cdot 10^{-03}}$	$1.945 \cdot 10^{-02}$	$6.831 \cdot 10^{-02}$	$1.948 \cdot 10^{-02}$	$6.749 \cdot 10^{-03}$	$8.978 \cdot 10^{+01}$	$4.774 \cdot 10^{-02}$	$5.219 \cdot 10^{-02}$
x	0.15	−1	$8.132 \cdot 10^{+01}$	$6.533 \cdot 10^{+01}$	$7.040 \cdot 10^{+01}$	$4.037 \cdot 10^{-02}$	$1.208 \cdot 10^{-02}$	$3.794 \cdot 10^{-02}$	$3.697 \cdot 10^{-02}$	$4.003 \cdot 10^{-02}$	$\mathbf{7.514 \cdot 10^{-03}}$	$9.549 \cdot 10^{+01}$	$6.135 \cdot 10^{-02}$	$1.189 \cdot 10^{-01}$
x	0.15	+1	$2.343 \cdot 10^{-01}$	$5.779 \cdot 10^{+01}$	$9.123 \cdot 10^{+01}$	$3.239 \cdot 10^{-02}$	$7.790 \cdot 10^{-03}$	$2.763 \cdot 10^{-02}$	$5.670 \cdot 10^{-02}$	$\mathbf{6.231 \cdot 10^{-03}}$	$8.821 \cdot 10^{-03}$	$9.235 \cdot 10^{+01}$	$8.375 \cdot 10^{-02}$	$1.035 \cdot 10^{-01}$
y	0.05	−1	$7.816 \cdot 10^{-01}$	$7.341 \cdot 10^{+00}$	$3.652 \cdot 10^{-01}$	$1.330 \cdot 10^{-02}$	$\mathbf{4.605 \cdot 10^{-03}}$	$1.176 \cdot 10^{-02}$	$6.113 \cdot 10^{-02}$	$1.068 \cdot 10^{-01}$	$6.162 \cdot 10^{-03}$	$9.971 \cdot 10^{+01}$	$1.679 \cdot 10^{-02}$	$4.760 \cdot 10^{-02}$
y	0.05	+1	$2.389 \cdot 10^{-02}$	$3.926 \cdot 10^{+01}$	$3.543 \cdot 10^{-02}$	$1.123 \cdot 10^{-02}$	$\mathbf{1.535 \cdot 10^{-03}}$	$1.125 \cdot 10^{-02}$	$8.805 \cdot 10^{-02}$	$1.183 \cdot 10^{-01}$	$5.272 \cdot 10^{-03}$	$7.645 \cdot 10^{-01}$	$1.257 \cdot 10^{-01}$	$4.719 \cdot 10^{-02}$
y	0.10	−1	$3.274 \cdot 10^{-01}$	$1.375 \cdot 10^{-01}$	$4.415 \cdot 10^{+01}$	$6.051 \cdot 10^{-02}$	$\mathbf{7.219 \cdot 10^{-03}}$	$2.329 \cdot 10^{-02}$	$4.440 \cdot 10^{-02}$	$1.313 \cdot 10^{-02}$	$8.210 \cdot 10^{-03}$	$8.687 \cdot 10^{+01}$		$3.394 \cdot 10^{-01}$
y	0.10	+1	$1.507 \cdot 10^{+00}$	$9.844 \cdot 10^{-01}$	$8.408 \cdot 10^{+01}$	$2.577 \cdot 10^{-02}$	$\mathbf{3.860 \cdot 10^{-03}}$	$2.170 \cdot 10^{-02}$	$6.431 \cdot 10^{-02}$	$1.872 \cdot 10^{-02}$	$6.231 \cdot 10^{-03}$	$9.777 \cdot 10^{+01}$	$8.420 \cdot 10^{-01}$	$1.474 \cdot 10^{-01}$
y	0.15	−1	$1.673 \cdot 10^{-01}$	$9.568 \cdot 10^{+01}$	$9.338 \cdot 10^{+01}$	$5.913 \cdot 10^{-02}$	$8.282 \cdot 10^{-03}$	$3.617 \cdot 10^{-02}$	$4.242 \cdot 10^{-02}$	$1.734 \cdot 10^{-01}$	$\mathbf{4.545 \cdot 10^{-03}}$	$7.668 \cdot 10^{+01}$	$8.929 \cdot 10^{-01}$	$3.684 \cdot 10^{-01}$
y	0.15	+1	$5.530 \cdot 10^{-02}$	$2.243 \cdot 10^{-01}$	$8.569 \cdot 10^{+01}$	$3.376 \cdot 10^{-02}$	$\mathbf{4.596 \cdot 10^{-03}}$	$3.217 \cdot 10^{-02}$	$9.957 \cdot 10^{-02}$	$1.681 \cdot 10^{-02}$	$7.438 \cdot 10^{-03}$	$8.852 \cdot 10^{+01}$	$8.966 \cdot 10^{-02}$	$4.331 \cdot 10^{-01}$
z	0.05	−1	$7.190 \cdot 10^{-01}$	$6.824 \cdot 10^{-02}$	$1.459 \cdot 10^{-02}$	$1.884 \cdot 10^{-02}$	$1.341 \cdot 10^{-02}$	$1.378 \cdot 10^{-01}$	$\mathbf{3.352 \cdot 10^{-05}}$	$3.384 \cdot 10^{-02}$	$6.639 \cdot 10^{-04}$	$8.924 \cdot 10^{+01}$	$8.853 \cdot 10^{+01}$	$8.477 \cdot 10^{-03}$
z	0.05	+1	$4.424 \cdot 10^{-02}$	$9.158 \cdot 10^{-01}$	$3.516 \cdot 10^{-02}$	$1.100 \cdot 10^{-02}$	$2.242 \cdot 10^{-03}$	$\mathbf{5.034 \cdot 10^{-05}}$	$6.571 \cdot 10^{-02}$	$1.543 \cdot 10^{-02}$	$7.846 \cdot 10^{-03}$	$8.608 \cdot 10^{+01}$	$4.397 \cdot 10^{-02}$	$4.876 \cdot 10^{-02}$
z	0.10	−1	$4.795 \cdot 10^{-02}$	$1.713 \cdot 10^{-01}$	$1.359 \cdot 10^{-03}$	$7.637 \cdot 10^{-03}$	$1.201 \cdot 10^{-02}$	$\mathbf{1.881 \cdot 10^{-04}}$	$1.635 \cdot 10^{-01}$	$3.511 \cdot 10^{-02}$	$4.790 \cdot 10^{-03}$	$8.267 \cdot 10^{+01}$	$9.102 \cdot 10^{+01}$	$1.454 \cdot 10^{-02}$
z	0.10	+1	$1.956 \cdot 10^{-02}$	$6.178 \cdot 10^{+01}$	$7.406 \cdot 10^{-02}$	$4.550 \cdot 10^{-02}$	$1.791 \cdot 10^{-03}$	$\mathbf{1.420 \cdot 10^{-05}}$	$1.338 \cdot 10^{-01}$	$7.085 \cdot 10^{-01}$	$1.057 \cdot 10^{-02}$	$8.167 \cdot 10^{+01}$	$9.187 \cdot 10^{+01}$	$4.479 \cdot 10^{-02}$
z	0.15	−1	$1.814 \cdot 10^{-01}$	$2.177 \cdot 10^{-01}$	$1.465 \cdot 10^{-02}$	$5.672 \cdot 10^{-03}$	$1.048 \cdot 10^{-02}$	$\mathbf{1.034 \cdot 10^{-03}}$	$2.194 \cdot 10^{-01}$	$9.012 \cdot 10^{-02}$	$7.337 \cdot 10^{-03}$	$8.219 \cdot 10^{+01}$	$8.410 \cdot 10^{+01}$	$6.388 \cdot 10^{+01}$
z	0.15	+1	$8.281 \cdot 10^{-01}$	$8.057 \cdot 10^{+01}$	$1.800 \cdot 10^{-01}$	$3.765 \cdot 10^{-02}$	$3.559 \cdot 10^{-03}$	$\mathbf{2.433 \cdot 10^{-04}}$	$1.478 \cdot 10^{-01}$	$6.156 \cdot 10^{-01}$	$1.304 \cdot 10^{-02}$	$2.280 \cdot 10^{+01}$	$8.416 \cdot 10^{+01}$	$8.013 \cdot 10^{+00}$

Table 6: Rotational error: Average error is computed for the last 300 nodes, i.e. for the last 0.6 s of the trajectory. We used a factor of 4 for the integration time, i.e. the integration constant is 0.008 s with a real-time control frequency of 125 Hz. Bold types of minimum values are considered experiment (i.e. row) wise.

direction	radius	orientation	5-standard	10-standard	20-standard	5-standard-angled	10-standard-angled	20-standard-angled	5-rotated	10-rotated	20-rotated	5-human	10-human	20-human
x	0.05	−1	$5.649 \cdot 10^{+01}$	$6.690 \cdot 10^{+01}$	$6.725 \cdot 10^{+01}$	$1.076 \cdot 10^{-02}$	$1.016 \cdot 10^{-02}$	$6.126 \cdot 10^{-02}$	$1.388 \cdot 10^{-02}$	$\mathbf{4.757 \cdot 10^{-03}}$	$2.000 \cdot 10^{-02}$	$2.460 \cdot 10^{-02}$	$5.401 \cdot 10^{-02}$	$1.055 \cdot 10^{-01}$
x	0.05	+1	$3.720 \cdot 10^{-01}$	$7.709 \cdot 10^{+01}$	$9.353 \cdot 10^{+01}$	$1.371 \cdot 10^{-02}$	$9.335 \cdot 10^{-03}$	$5.354 \cdot 10^{-02}$	$1.443 \cdot 10^{-02}$	$\mathbf{5.721 \cdot 10^{-03}}$	$1.668 \cdot 10^{-02}$	$4.320 \cdot 10^{-02}$	$1.070 \cdot 10^{-02}$	$8.744 \cdot 10^{-02}$
x	0.10	−1	$6.765 \cdot 10^{-01}$	$6.230 \cdot 10^{+01}$	$7.365 \cdot 10^{+01}$	$4.232 \cdot 10^{-02}$	$2.924 \cdot 10^{-02}$	$1.261 \cdot 10^{-01}$	$8.542 \cdot 10^{-02}$	$\mathbf{6.325 \cdot 10^{-03}}$	$4.140 \cdot 10^{-02}$	$4.347 \cdot 10^{-02}$	$8.764 \cdot 10^{-02}$	$2.284 \cdot 10^{-01}$
x	0.10	+1	$5.604 \cdot 10^{+01}$	$8.795 \cdot 10^{+01}$	$9.460 \cdot 10^{+01}$	$3.261 \cdot 10^{-02}$	$2.964 \cdot 10^{-02}$	$4.937 \cdot 10^{-01}$	$\mathbf{8.584 \cdot 10^{-03}}$	$9.019 \cdot 10^{-02}$	$3.072 \cdot 10^{-02}$	$6.244 \cdot 10^{-02}$	$4.441 \cdot 10^{-02}$	$1.722 \cdot 10^{-01}$
x	0.15	−1	$5.785 \cdot 10^{+01}$	$9.445 \cdot 10^{+01}$	$7.359 \cdot 10^{+01}$	$6.296 \cdot 10^{-02}$	$3.348 \cdot 10^{-02}$	$1.889 \cdot 10^{-01}$	$1.083 \cdot 10^{-02}$	$\mathbf{8.285 \cdot 10^{-03}}$	$6.491 \cdot 10^{-02}$	$6.900 \cdot 10^{-02}$	$1.196 \cdot 10^{-01}$	$1.961 \cdot 10^{-02}$
x	0.15	+1	$5.779 \cdot 10^{+01}$	$8.512 \cdot 10^{+01}$	$5.243 \cdot 10^{+01}$	$7.124 \cdot 10^{-02}$	$1.764 \cdot 10^{-02}$	$3.385 \cdot 10^{-01}$	$\mathbf{7.754 \cdot 10^{-03}}$	$1.297 \cdot 10^{-02}$	$4.445 \cdot 10^{-02}$	$1.122 \cdot 10^{-01}$	$8.224 \cdot 10^{-02}$	$2.610 \cdot 10^{-01}$
y	0.05	−1	$1.988 \cdot 10^{-01}$	$3.193 \cdot 10^{-02}$	$1.306 \cdot 10^{-01}$	$\mathbf{2.668 \cdot 10^{-03}}$	$1.518 \cdot 10^{-02}$	$5.678 \cdot 10^{-02}$	$1.474 \cdot 10^{-02}$	$4.760 \cdot 10^{-03}$	$2.480 \cdot 10^{-02}$	$4.904 \cdot 10^{-02}$	$5.175 \cdot 10^{-02}$	$5.853 \cdot 10^{-03}$
y	0.05	+1	$7.424 \cdot 10^{-01}$	$8.217 \cdot 10^{+01}$	$4.210 \cdot 10^{-01}$	$\mathbf{2.838 \cdot 10^{-03}}$	$9.286 \cdot 10^{-03}$	$1.350 \cdot 10^{-01}$	$1.628 \cdot 10^{-02}$	$5.576 \cdot 10^{-03}$	$1.529 \cdot 10^{-02}$	$3.480 \cdot 10^{-01}$	$4.453 \cdot 10^{-02}$	$4.603 \cdot 10^{-03}$
y	0.10	−1	$1.250 \cdot 10^{-01}$	$8.759 \cdot 10^{+01}$	$8.716 \cdot 10^{+01}$	$4.157 \cdot 10^{-02}$	$2.403 \cdot 10^{-02}$	$1.139 \cdot 10^{-01}$	$1.358 \cdot 10^{-02}$	$\mathbf{5.004 \cdot 10^{-03}}$	$4.031 \cdot 10^{-02}$	$9.971 \cdot 10^{+01}$	$2.607 \cdot 10^{-01}$	$1.143 \cdot 10^{-01}$
y	0.10	+1	$9.357 \cdot 10^{-02}$	$9.536 \cdot 10^{+01}$	$7.022 \cdot 10^{+01}$	$4.544 \cdot 10^{-02}$	$1.731 \cdot 10^{-02}$	$8.293 \cdot 10^{-01}$	$1.867 \cdot 10^{-02}$	$\mathbf{7.184 \cdot 10^{-03}}$	$3.743 \cdot 10^{-02}$	$8.252 \cdot 10^{+01}$	$1.501 \cdot 10^{-01}$	$4.849 \cdot 10^{-02}$
y	0.15	−1	$6.524 \cdot 10^{+01}$	$8.560 \cdot 10^{+01}$	$5.468 \cdot 10^{+01}$	$4.490 \cdot 10^{-02}$	$3.041 \cdot 10^{-02}$	$5.291 \cdot 10^{-01}$	$1.515 \cdot 10^{-02}$	$\mathbf{3.650 \cdot 10^{-03}}$	$5.629 \cdot 10^{-02}$	$8.275 \cdot 10^{+01}$	$9.052 \cdot 10^{-01}$	$2.302 \cdot 10^{-01}$
y	0.15	+1	$5.067 \cdot 10^{-02}$	$5.184 \cdot 10^{+01}$	$6.993 \cdot 10^{+01}$	$3.074 \cdot 10^{-02}$	$2.009 \cdot 10^{+01}$	$6.847 \cdot 10^{-02}$	$2.197 \cdot 10^{-02}$	$\mathbf{8.828 \cdot 10^{-03}}$	$6.016 \cdot 10^{-02}$	$9.426 \cdot 10^{+01}$	$3.386 \cdot 10^{-01}$	$1.310 \cdot 10^{-01}$
z	0.05	−1	$9.377 \cdot 10^{-02}$	$1.561 \cdot 10^{-03}$	$1.400 \cdot 10^{-03}$	$3.856 \cdot 10^{-03}$	$\mathbf{1.097 \cdot 10^{-05}}$	$1.942 \cdot 10^{-04}$	$1.907 \cdot 10^{-02}$	$5.070 \cdot 10^{-04}$	$7.010 \cdot 10^{-04}$	$9.525 \cdot 10^{-03}$	$3.501 \cdot 10^{-03}$	$6.374 \cdot 10^{-03}$
z	0.05	+1	$9.284 \cdot 10^{-02}$	$2.296 \cdot 10^{-02}$	$9.529 \cdot 10^{-03}$	$7.770 \cdot 10^{-03}$	$\mathbf{5.617 \cdot 10^{-05}}$	$1.918 \cdot 10^{-04}$	$2.504 \cdot 10^{-02}$	$7.762 \cdot 10^{-03}$	$9.576 \cdot 10^{-03}$	$1.324 \cdot 10^{-01}$	$5.482 \cdot 10^{-02}$	$1.024 \cdot 10^{-02}$
z	0.10	−1	$1.028 \cdot 10^{-01}$	$2.060 \cdot 10^{-03}$	$2.029 \cdot 10^{-03}$	$1.347 \cdot 10^{-03}$	$3.108 \cdot 10^{-01}$	$\mathbf{1.069 \cdot 10^{-04}}$	$3.581 \cdot 10^{-02}$	$4.295 \cdot 10^{-03}$	$3.814 \cdot 10^{-02}$	$1.057 \cdot 10^{+02}$	$2.677 \cdot 10^{-02}$	$1.562 \cdot 10^{-02}$
z	0.10	+1	$1.728 \cdot 10^{-01}$	$4.894 \cdot 10^{-02}$	$1.653 \cdot 10^{-01}$	$4.803 \cdot 10^{-03}$	$\mathbf{2.041 \cdot 10^{-04}}$	$3.906 \cdot 10^{-04}$	$2.799 \cdot 10^{-02}$	$1.081 \cdot 10^{-02}$	$1.328 \cdot 10^{-02}$	$8.000 \cdot 10^{-01}$	$8.307 \cdot 10^{-02}$	$1.078 \cdot 10^{-02}$
z	0.15	−1	$1.113 \cdot 10^{-01}$	$5.690 \cdot 10^{-02}$	$3.449 \cdot 10^{-03}$	$1.724 \cdot 10^{-02}$	$\mathbf{2.738 \cdot 10^{-04}}$	$8.315 \cdot 10^{-04}$	$4.416 \cdot 10^{-02}$	$6.984 \cdot 10^{-03}$	$7.624 \cdot 10^{-03}$	$9.398 \cdot 10^{+01}$	$6.984 \cdot 10^{-02}$	$3.202 \cdot 10^{-02}$
z	0.15	+1	$8.683 \cdot 10^{+01}$	$6.126 \cdot 10^{+01}$	$1.014 \cdot 10^{+00}$	$1.741 \cdot 10^{-02}$	$\mathbf{5.502 \cdot 10^{-04}}$	$8.315 \cdot 10^{-04}$	$4.418 \cdot 10^{-02}$	$1.235 \cdot 10^{-02}$	$1.649 \cdot 10^{-02}$	$1.026 \cdot 10^{+00}$	$1.985 \cdot 10^{-01}$	$9.731 \cdot 10^{-02}$

Table 7: Computional time: Average error is computed for the last 300 nodes, i.e. for the last 0.6 s of the trajectory. We used a factor of 1 for the integration time, i.e. the integration constant is 0.002 s with a real-time control frequency of 500 Hz. Bold types of minimum values are considered experiment (i.e. row) wise.

direction	radius	orientation	5-standard	10-standard	20-standard	5-standard-angled	10-standard-angled	20-standard-angled	5-rotated	10-rotated	20-rotated	5-human	10-human	20-human
x	0.05	−1	$1.421 \cdot 10^{+01}$	$2.065 \cdot 10^{+01}$	$6.381 \cdot 10^{+01}$	$1.011 \cdot 10^{+01}$	$2.722 \cdot 10^{+01}$	$1.369 \cdot 10^{+01}$	$1.330 \cdot 10^{+01}$	$2.827 \cdot 10^{+01}$	$6.186 \cdot 10^{+01}$	$\mathbf{3.442 \cdot 10^{+00}}$	$1.641 \cdot 10^{+01}$	$1.508 \cdot 10^{+01}$
x	0.05	+1	$1.134 \cdot 10^{+01}$	$2.686 \cdot 10^{+01}$	$4.458 \cdot 10^{+01}$	$1.041 \cdot 10^{+01}$	$2.718 \cdot 10^{+01}$	$2.513 \cdot 10^{+01}$	$1.411 \cdot 10^{+01}$	$2.821 \cdot 10^{+01}$	$6.185 \cdot 10^{+01}$	$\mathbf{3.819 \cdot 10^{+00}}$	$1.912 \cdot 10^{+01}$	$3.449 \cdot 10^{+01}$
x	0.10	−1	$1.510 \cdot 10^{+01}$	$2.599 \cdot 10^{+01}$	$4.716 \cdot 10^{+01}$	$1.040 \cdot 10^{+01}$	$2.720 \cdot 10^{+01}$	$1.998 \cdot 10^{+01}$	$1.207 \cdot 10^{+01}$	$2.808 \cdot 10^{+01}$	$6.037 \cdot 10^{+01}$	$\mathbf{4.354 \cdot 10^{+00}}$	$1.353 \cdot 10^{+01}$	$2.387 \cdot 10^{+01}$
x	0.10	+1	$1.056 \cdot 10^{+01}$	$2.784 \cdot 10^{+01}$	$6.215 \cdot 10^{+01}$	$1.017 \cdot 10^{+01}$	$2.682 \cdot 10^{+01}$	$1.796 \cdot 10^{+01}$	$1.325 \cdot 10^{+01}$	$2.816 \cdot 10^{+01}$	$6.269 \cdot 10^{+01}$	$\mathbf{3.881 \cdot 10^{+00}}$	$1.804 \cdot 10^{+01}$	$3.485 \cdot 10^{+01}$
x	0.15	−1	$1.176 \cdot 10^{+01}$	$2.461 \cdot 10^{+01}$	$2.442 \cdot 10^{+01}$	$1.024 \cdot 10^{+01}$	$2.642 \cdot 10^{+01}$	$1.984 \cdot 10^{+01}$	$1.384 \cdot 10^{+01}$	$2.815 \cdot 10^{+01}$	$6.093 \cdot 10^{+01}$	$\mathbf{3.478 \cdot 10^{+00}}$	$1.375 \cdot 10^{+01}$	$2.660 \cdot 10^{+01}$
x	0.15	+1	$1.103 \cdot 10^{+01}$	$2.316 \cdot 10^{+01}$	$2.312 \cdot 10^{+01}$	$1.044 \cdot 10^{+01}$	$2.624 \cdot 10^{+01}$	$1.927 \cdot 10^{+01}$	$1.500 \cdot 10^{+01}$	$2.910 \cdot 10^{+01}$	$6.100 \cdot 10^{+01}$	$\mathbf{3.586 \cdot 10^{+00}}$	$1.876 \cdot 10^{+01}$	$3.477 \cdot 10^{+01}$
y	0.05	−1	$1.139 \cdot 10^{+01}$	$3.138 \cdot 10^{+01}$	$4.810 \cdot 10^{+01}$	$9.587 \cdot 10^{+00}$	$2.704 \cdot 10^{+01}$	$2.704 \cdot 10^{+01}$	$1.175 \cdot 10^{+01}$	$2.836 \cdot 10^{+01}$	$6.338 \cdot 10^{+01}$	$\mathbf{5.235 \cdot 10^{+00}}$	$1.639 \cdot 10^{+01}$	$4.507 \cdot 10^{+01}$
y	0.05	+1	$1.164 \cdot 10^{+01}$	$1.855 \cdot 10^{+01}$	$6.326 \cdot 10^{+01}$	$1.065 \cdot 10^{+01}$	$2.683 \cdot 10^{+01}$	$2.370 \cdot 10^{+01}$	$1.226 \cdot 10^{+01}$	$2.915 \cdot 10^{+01}$	$6.110 \cdot 10^{+01}$	$\mathbf{4.393 \cdot 10^{+00}}$	$1.755 \cdot 10^{+01}$	$3.802 \cdot 10^{+01}$
y	0.10	−1	$1.207 \cdot 10^{+01}$	$2.227 \cdot 10^{+01}$	$1.939 \cdot 10^{+01}$	$9.138 \cdot 10^{+00}$	$2.703 \cdot 10^{+01}$	$2.038 \cdot 10^{+01}$	$9.642 \cdot 10^{+00}$	$2.847 \cdot 10^{+01}$	$6.401 \cdot 10^{+01}$	$\mathbf{2.600 \cdot 10^{+00}}$	$2.275 \cdot 10^{+01}$	$7.120 \cdot 10^{+01}$
y	0.10	+1	$1.114 \cdot 10^{+01}$	$2.854 \cdot 10^{+01}$	$4.561 \cdot 10^{+01}$	$1.065 \cdot 10^{+01}$	$2.733 \cdot 10^{+01}$	$1.793 \cdot 10^{+01}$	$1.336 \cdot 10^{+01}$	$2.668 \cdot 10^{+01}$	$6.075 \cdot 10^{+01}$	$\mathbf{8.369 \cdot 10^{+00}}$	$2.119 \cdot 10^{+01}$	$3.644 \cdot 10^{+01}$
y	0.15	−1	$1.139 \cdot 10^{+01}$	$1.932 \cdot 10^{+01}$	$3.384 \cdot 10^{+01}$	$9.505 \cdot 10^{+00}$	$2.620 \cdot 10^{+01}$	$2.029 \cdot 10^{+01}$	$1.190 \cdot 10^{+01}$	$3.031 \cdot 10^{+01}$	$6.117 \cdot 10^{+01}$	$\mathbf{3.782 \cdot 10^{+00}}$	$1.765 \cdot 10^{+01}$	$4.482 \cdot 10^{+01}$
y	0.15	+1	$1.081 \cdot 10^{+01}$	$1.866 \cdot 10^{+01}$	$4.276 \cdot 10^{+01}$	$1.064 \cdot 10^{+01}$	$2.671 \cdot 10^{+01}$	$1.826 \cdot 10^{+01}$	$1.213 \cdot 10^{+01}$	$2.884 \cdot 10^{+01}$	$6.074 \cdot 10^{+01}$	$\mathbf{4.942 \cdot 10^{+00}}$	$1.737 \cdot 10^{+01}$	$5.010 \cdot 10^{+01}$
z	0.05	−1	$1.088 \cdot 10^{+01}$	$2.674 \cdot 10^{+01}$	$6.773 \cdot 10^{+01}$	$1.042 \cdot 10^{+01}$	$2.473 \cdot 10^{+01}$	$4.415 \cdot 10^{+01}$	$8.035 \cdot 10^{+00}$	$3.458 \cdot 10^{+01}$	$6.050 \cdot 10^{+01}$	$\mathbf{3.303 \cdot 10^{+00}}$	$2.094 \cdot 10^{+01}$	$5.351 \cdot 10^{+01}$
z	0.05	+1	$1.211 \cdot 10^{+01}$	$2.166 \cdot 10^{+01}$	$7.401 \cdot 10^{+01}$	$1.133 \cdot 10^{+01}$	$2.592 \cdot 10^{+01}$	$4.907 \cdot 10^{+01}$	$1.418 \cdot 10^{+01}$	$2.074 \cdot 10^{+01}$	$4.620 \cdot 10^{+01}$	$\mathbf{3.816 \cdot 10^{+00}}$	$1.495 \cdot 10^{+01}$	$5.100 \cdot 10^{+01}$
z	0.10	−1	$1.242 \cdot 10^{+01}$	$2.130 \cdot 10^{+01}$	$4.895 \cdot 10^{+01}$	$\mathbf{3.099 \cdot 10^{+00}}$	$2.019 \cdot 10^{+01}$	$4.248 \cdot 10^{+01}$	$7.992 \cdot 10^{+00}$	$2.333 \cdot 10^{+01}$	$6.171 \cdot 10^{+01}$	$4.620 \cdot 10^{+01}$	$1.478 \cdot 10^{+01}$	$4.464 \cdot 10^{+01}$
z	0.10	+1	$9.087 \cdot 10^{+00}$	$3.304 \cdot 10^{+01}$	$6.840 \cdot 10^{+01}$	$1.003 \cdot 10^{+01}$	$2.850 \cdot 10^{+01}$	$5.248 \cdot 10^{+01}$	$1.306 \cdot 10^{+01}$	$2.633 \cdot 10^{+01}$	$6.162 \cdot 10^{+01}$	$\mathbf{3.130 \cdot 10^{+00}}$	$2.812 \cdot 10^{+01}$	$7.809 \cdot 10^{+01}$
z	0.15	−1	$9.263 \cdot 10^{+00}$	$3.668 \cdot 10^{+01}$	$5.096 \cdot 10^{+01}$	$\mathbf{1.445 \cdot 10^{+00}}$	$3.570 \cdot 10^{+01}$	$4.905 \cdot 10^{+01}$	$5.163 \cdot 10^{+01}$	$3.675 \cdot 10^{+01}$	$7.191 \cdot 10^{+01}$	$4.437 \cdot 10^{+01}$	$2.091 \cdot 10^{+01}$	$7.985 \cdot 10^{+01}$
z	0.15	+1	$8.420 \cdot 10^{+00}$	$3.501 \cdot 10^{+01}$	$6.647 \cdot 10^{+01}$	$1.002 \cdot 10^{+01}$	$3.292 \cdot 10^{+01}$	$5.135 \cdot 10^{+01}$	$1.141 \cdot 10^{+01}$	$2.193 \cdot 10^{+01}$	$6.369 \cdot 10^{+01}$	$\mathbf{6.970 \cdot 10^{+00}}$	$2.534 \cdot 10^{+01}$	$6.487 \cdot 10^{+01}$

Table 8: Computional time: Average error is computed for the last 300 nodes, i.e. for the last 0.6 s of the trajectory. We used a factor of 2 for the integration time, i.e. the integration constant is 0.004 s with a real-time control frequency of 250 Hz. Bold types of minimum values are considered experiment (i.e. row) wise.

direction	radius	orientation	5-standard	10-standard	20-standard	5-standard-angled	10-standard-angled	20-standard-angled	5-rotated	10-rotated	20-rotated	5-human	10-human	20-human
x	0.05	−1	$6.005 \cdot 10^{+00}$	$7.404 \cdot 10^{+00}$	$1.852 \cdot 10^{+01}$	$4.736 \cdot 10^{+00}$	$1.210 \cdot 10^{+01}$	$1.412 \cdot 10^{+01}$	$5.397 \cdot 10^{+00}$	$1.563 \cdot 10^{+00}$	$3.469 \cdot 10^{+00}$	$4.095 \cdot 10^{+00}$	$\mathbf{1.538 \cdot 10^{+00}}$	$2.872 \cdot 10^{+01}$
x	0.05	+1	$6.443 \cdot 10^{+00}$	$1.178 \cdot 10^{+01}$	$9.745 \cdot 10^{+00}$	$4.864 \cdot 10^{+00}$	$1.229 \cdot 10^{+01}$	$1.380 \cdot 10^{+01}$	$5.351 \cdot 10^{+00}$	$8.480 \cdot 10^{+00}$	$\mathbf{3.517 \cdot 10^{+00}}$	$4.430 \cdot 10^{+00}$	$9.753 \cdot 10^{+00}$	$1.090 \cdot 10^{+01}$
x	0.10	−1	$5.148 \cdot 10^{+00}$	$7.325 \cdot 10^{+00}$	$1.192 \cdot 10^{+01}$	$4.116 \cdot 10^{+00}$	$5.058 \cdot 10^{+00}$	$1.542 \cdot 10^{+01}$	$5.388 \cdot 10^{+00}$	$5.561 \cdot 10^{+00}$	$\mathbf{3.053 \cdot 10^{+00}}$	$4.484 \cdot 10^{+00}$	$5.122 \cdot 10^{+00}$	$2.513 \cdot 10^{+01}$
x	0.10	+1	$4.465 \cdot 10^{+00}$	$9.335 \cdot 10^{+00}$	$6.842 \cdot 10^{+00}$	$4.433 \cdot 10^{+00}$	$4.891 \cdot 10^{+00}$	$1.488 \cdot 10^{+01}$	$4.719 \cdot 10^{+00}$	$7.195 \cdot 10^{+00}$	$\mathbf{3.389 \cdot 10^{+00}}$	$4.943 \cdot 10^{+00}$	$9.138 \cdot 10^{+00}$	$1.565 \cdot 10^{+01}$
x	0.15	−1	$5.818 \cdot 10^{+00}$	$6.279 \cdot 10^{+00}$	$1.303 \cdot 10^{+01}$	$4.729 \cdot 10^{+00}$	$4.990 \cdot 10^{+00}$	$1.532 \cdot 10^{+01}$	$4.812 \cdot 10^{+00}$	$8.812 \cdot 10^{+00}$	$\mathbf{2.855 \cdot 10^{+00}}$	$4.883 \cdot 10^{+00}$	$9.075 \cdot 10^{+00}$	$2.375 \cdot 10^{+01}$
x	0.15	+1	$5.259 \cdot 10^{+00}$	$7.526 \cdot 10^{+00}$	$2.148 \cdot 10^{+01}$	$4.708 \cdot 10^{+00}$	$4.553 \cdot 10^{+00}$	$4.990 \cdot 10^{+00}$	$4.471 \cdot 10^{+00}$	$5.023 \cdot 10^{+00}$	$\mathbf{2.849 \cdot 10^{+00}}$	$6.110 \cdot 10^{+00}$	$9.075 \cdot 10^{+00}$	$1.714 \cdot 10^{+01}$
y	0.05	−1	$6.867 \cdot 10^{+00}$	$7.526 \cdot 10^{+00}$	$2.148 \cdot 10^{+01}$	$4.498 \cdot 10^{+00}$	$1.223 \cdot 10^{+01}$	$1.386 \cdot 10^{+01}$	$5.371 \cdot 10^{+00}$	$5.612 \cdot 10^{+00}$	$7.915 \cdot 10^{+00}$	$\mathbf{3.982 \cdot 10^{+00}}$	$1.401 \cdot 10^{+01}$	$3.426 \cdot 10^{+01}$
y	0.05	+1	$4.325 \cdot 10^{+00}$	$9.682 \cdot 10^{+00}$	$1.590 \cdot 10^{+01}$	$4.660 \cdot 10^{+00}$	$1.209 \cdot 10^{+01}$	$1.343 \cdot 10^{+01}$	$5.266 \cdot 10^{+00}$	$5.742 \cdot 10^{+00}$	$7.200 \cdot 10^{+00}$	$\mathbf{3.018 \cdot 10^{+00}}$	$1.508 \cdot 10^{+01}$	$3.835 \cdot 10^{+01}$
y	0.10	−1	$5.478 \cdot 10^{+00}$	$1.415 \cdot 10^{+01}$	$2.283 \cdot 10^{+01}$	$4.635 \cdot 10^{+00}$	$5.939 \cdot 10^{+00}$	$1.466 \cdot 10^{+01}$	$4.805 \cdot 10^{+00}$	$5.472 \cdot 10^{+00}$	$5.757 \cdot 10^{+00}$	$\mathbf{4.409 \cdot 10^{+00}}$	$1.376 \cdot 10^{+01}$	$4.603 \cdot 10^{+01}$
y	0.10	+1	$6.435 \cdot 10^{+00}$	$1.179 \cdot 10^{+01}$	$1.692 \cdot 10^{+01}$	$3.974 \cdot 10^{+00}$	$6.392 \cdot 10^{+00}$	$1.573 \cdot 10^{+01}$	$5.138 \cdot 10^{+00}$	$5.436 \cdot 10^{+00}$	$3.775 \cdot 10^{+00}$	$\mathbf{3.329 \cdot 10^{+00}}$	$9.763 \cdot 10^{+00}$	$3.643 \cdot 10^{+01}$
y	0.15	−1	$4.458 \cdot 10^{+00}$	$\mathbf{3.136 \cdot 10^{+00}}$	$1.104 \cdot 10^{+01}$	$4.649 \cdot 10^{+00}$	$5.593 \cdot 10^{+00}$	$1.493 \cdot 10^{+01}$	$4.540 \cdot 10^{+00}$	$5.470 \cdot 10^{+00}$	$6.225 \cdot 10^{+00}$	$5.150 \cdot 10^{+00}$	$8.172 \cdot 10^{+00}$	$3.551 \cdot 10^{+01}$
y	0.15	+1	$4.408 \cdot 10^{+00}$	$1.192 \cdot 10^{+01}$	$1.079 \cdot 10^{+01}$	$3.845 \cdot 10^{+00}$	$5.202 \cdot 10^{+00}$	$1.148 \cdot 10^{+01}$	$4.809 \cdot 10^{+00}$	$6.225 \cdot 10^{+00}$	$\mathbf{3.687 \cdot 10^{+00}}$	$5.150 \cdot 10^{+00}$	$8.979 \cdot 10^{+00}$	$3.601 \cdot 10^{+01}$
z	0.05	−1	$4.715 \cdot 10^{+00}$	$1.402 \cdot 10^{+01}$	$1.968 \cdot 10^{+01}$	$\mathbf{4.600 \cdot 10^{+00}}$	$1.370 \cdot 10^{+01}$	$5.995 \cdot 10^{+00}$	$5.499 \cdot 10^{+00}$	$1.451 \cdot 10^{+01}$	$1.003 \cdot 10^{+01}$	$4.866 \cdot 10^{+00}$	$1.139 \cdot 10^{+01}$	$2.973 \cdot 10^{+01}$
z	0.05	+1	$4.733 \cdot 10^{+00}$	$1.685 \cdot 10^{+01}$	$4.389 \cdot 10^{+00}$	$4.583 \cdot 10^{+00}$	$1.376 \cdot 10^{+01}$	$\mathbf{3.243 \cdot 10^{+00}}$	$5.483 \cdot 10^{+00}$	$1.559 \cdot 10^{+01}$	$3.781 \cdot 10^{+00}$	$6.110 \cdot 10^{+00}$	$1.251 \cdot 10^{+01}$	$3.650 \cdot 10^{+01}$
z	0.10	−1	$6.666 \cdot 10^{+00}$	$1.408 \cdot 10^{+01}$	$1.726 \cdot 10^{+01}$	$\mathbf{4.737 \cdot 10^{+00}}$	$1.335 \cdot 10^{+01}$	$1.004 \cdot 10^{+01}$	$5.919 \cdot 10^{+00}$	$1.515 \cdot 10^{+01}$	$2.731 \cdot 10^{+01}$	$5.178 \cdot 10^{+00}$	$1.145 \cdot 10^{+01}$	$2.498 \cdot 10^{+01}$
z	0.10	+1	$4.932 \cdot 10^{+00}$	$1.647 \cdot 10^{+01}$	$2.819 \cdot 10^{+01}$	$4.815 \cdot 10^{+00}$	$1.331 \cdot 10^{+01}$	$\mathbf{3.441 \cdot 10^{+00}}$	$6.056 \cdot 10^{+00}$	$1.738 \cdot 10^{+01}$	$3.923 \cdot 10^{+00}$	$3.457 \cdot 10^{+00}$	$1.712 \cdot 10^{+01}$	$3.909 \cdot 10^{+01}$
z	0.15	−1	$4.276 \cdot 10^{+00}$	$1.399 \cdot 10^{+01}$	$2.483 \cdot 10^{+01}$	$4.986 \cdot 10^{+00}$	$1.303 \cdot 10^{+01}$	$2.443 \cdot 10^{+01}$	$6.695 \cdot 10^{+00}$	$1.540 \cdot 10^{+01}$	$3.524 \cdot 10^{+01}$	$\mathbf{2.273 \cdot 10^{+00}}$	$1.436 \cdot 10^{+01}$	$4.735 \cdot 10^{+01}$
z	0.15	+1	$7.404 \cdot 10^{+00}$	$1.200 \cdot 10^{+01}$	$3.193 \cdot 10^{+01}$	$\mathbf{4.456 \cdot 10^{+00}}$	$1.336 \cdot 10^{+01}$	$6.712 \cdot 10^{+00}$	$6.119 \cdot 10^{+00}$	$1.861 \cdot 10^{+01}$	$3.944 \cdot 10^{+01}$	$8.323 \cdot 10^{+00}$	$1.268 \cdot 10^{+01}$	$4.205 \cdot 10^{+01}$

Table 9: Computional time: Average error is computed for the last 300 nodes, i.e. for the last 0.6 s of the trajectory. We used a factor of 4 for the integration time, i.e. the integration constant is 0.008 s with a real-time control frequency of 125 Hz. Bold types of minimum values are considered experiment (i.e. row) wise.

direction	radius	orientation	5-standard	10-standard	20-standard	5-standard-angled	10-standard-angled	20-standard-angled	5-rotated	10-rotated	20-rotated	5-human	10-human	20-human
x	0.05	−1	$2.377 \cdot 10^{+00}$	$2.261 \cdot 10^{+00}$	$4.150 \cdot 10^{+00}$	$2.621 \cdot 10^{+00}$	$3.402 \cdot 10^{+00}$	$8.465 \cdot 10^{+00}$	$1.202 \cdot 10^{+00}$	$8.442 \cdot 10^{-01}$	$6.344 \cdot 10^{+00}$	$\mathbf{5.715 \cdot 10^{-01}}$	$6.986 \cdot 10^{+00}$	$1.358 \cdot 10^{+01}$
x	0.05	+1	$2.338 \cdot 10^{+00}$	$2.233 \cdot 10^{+00}$	$4.740 \cdot 10^{+00}$	$2.669 \cdot 10^{+00}$	$3.361 \cdot 10^{+00}$	$8.120 \cdot 10^{+00}$	$1.300 \cdot 10^{+00}$	$\mathbf{8.639 \cdot 10^{-01}}$	$6.187 \cdot 10^{+00}$	$2.437 \cdot 10^{+00}$	$2.798 \cdot 10^{+00}$	$1.338 \cdot 10^{+01}$
x	0.10	−1	$2.094 \cdot 10^{+00}$	$1.326 \cdot 10^{+00}$	$3.590 \cdot 10^{+00}$	$8.166 \cdot 10^{-01}$	$2.803 \cdot 10^{+00}$	$9.434 \cdot 10^{+00}$	$8.091 \cdot 10^{-01}$	$8.250 \cdot 10^{-01}$	$6.715 \cdot 10^{+00}$	$\mathbf{7.793 \cdot 10^{-01}}$	$5.927 \cdot 10^{+00}$	$7.924 \cdot 10^{+00}$
x	0.10	+1	$2.038 \cdot 10^{+00}$	$2.879 \cdot 10^{+00}$	$8.962 \cdot 10^{-01}$	$\mathbf{7.918 \cdot 10^{-01}}$	$2.664 \cdot 10^{+00}$	$8.701 \cdot 10^{+00}$	$8.613 \cdot 10^{-01}$	$8.230 \cdot 10^{-01}$	$6.392 \cdot 10^{+00}$	$2.076 \cdot 10^{+00}$	$3.809 \cdot 10^{+00}$	$1.371 \cdot 10^{+01}$
x	0.15	−1	$1.438 \cdot 10^{+00}$	$1.740 \cdot 10^{+00}$	$2.451 \cdot 10^{+00}$	$9.048 \cdot 10^{-01}$	$3.227 \cdot 10^{+00}$	$8.878 \cdot 10^{+00}$	$\mathbf{6.485 \cdot 10^{-01}}$	$8.011 \cdot 10^{-01}$	$6.800 \cdot 10^{+00}$	$1.241 \cdot 10^{+00}$	$5.715 \cdot 10^{+00}$	$1.236 \cdot 10^{+01}$
x	0.15	+1	$1.541 \cdot 10^{+00}$	$9.056 \cdot 10^{-01}$	$3.244 \cdot 10^{+00}$	$8.413 \cdot 10^{-01}$	$2.526 \cdot 10^{+00}$	$8.677 \cdot 10^{+00}$	$9.513 \cdot 10^{-01}$	$\mathbf{8.015 \cdot 10^{-01}}$	$6.548 \cdot 10^{+00}$	$1.760 \cdot 10^{+00}$	$4.266 \cdot 10^{+00}$	$1.431 \cdot 10^{+01}$
y	0.05	−1	$2.460 \cdot 10^{+00}$	$4.902 \cdot 10^{+00}$	$9.440 \cdot 10^{+00}$	$2.610 \cdot 10^{+00}$	$2.420 \cdot 10^{+00}$	$1.210 \cdot 10^{+01}$	$\mathbf{9.787 \cdot 10^{-01}}$	$2.197 \cdot 10^{+00}$	$7.701 \cdot 10^{+00}$	$3.315 \cdot 10^{+00}$	$8.564 \cdot 10^{+00}$	$1.474 \cdot 10^{+01}$
y	0.05	+1	$2.832 \cdot 10^{+00}$	$6.122 \cdot 10^{+00}$	$9.156 \cdot 10^{+00}$	$2.567 \cdot 10^{+00}$	$3.550 \cdot 10^{+00}$	$1.005 \cdot 10^{+01}$	$\mathbf{1.104 \cdot 10^{+00}}$	$1.651 \cdot 10^{+00}$	$5.671 \cdot 10^{+00}$	$4.048 \cdot 10^{+00}$	$1.018 \cdot 10^{+01}$	$1.412 \cdot 10^{+01}$
y	0.10	−1	$2.147 \cdot 10^{+00}$	$1.840 \cdot 10^{+00}$	$5.060 \cdot 10^{+00}$	$\mathbf{9.574 \cdot 10^{-01}}$	$3.222 \cdot 10^{+00}$	$9.827 \cdot 10^{+00}$	$9.743 \cdot 10^{-01}$	$1.462 \cdot 10^{+00}$	$7.211 \cdot 10^{+00}$	$3.074 \cdot 10^{+00}$	$9.617 \cdot 10^{+00}$	$1.618 \cdot 10^{+01}$
y	0.10	+1	$2.506 \cdot 10^{+00}$	$1.856 \cdot 10^{+00}$	$3.619 \cdot 10^{+00}$	$\mathbf{7.974 \cdot 10^{-01}}$	$1.947 \cdot 10^{+00}$	$7.003 \cdot 10^{+00}$	$8.612 \cdot 10^{-01}$	$1.121 \cdot 10^{+00}$	$6.091 \cdot 10^{+00}$	$2.614 \cdot 10^{+00}$	$8.669 \cdot 10^{+00}$	$1.427 \cdot 10^{+01}$
y	0.15	−1	$1.202 \cdot 10^{+00}$	$2.371 \cdot 10^{+00}$	$1.605 \cdot 10^{+00}$	$\mathbf{8.357 \cdot 10^{-01}}$	$3.165 \cdot 10^{+00}$	$8.775 \cdot 10^{+00}$	$8.570 \cdot 10^{-01}$	$1.142 \cdot 10^{+00}$	$5.485 \cdot 10^{+00}$	$2.595 \cdot 10^{+00}$	$8.441 \cdot 10^{+00}$	$1.556 \cdot 10^{+01}$
y	0.15	+1	$2.255 \cdot 10^{+00}$	$1.411 \cdot 10^{+00}$	$3.052 \cdot 10^{+00}$	$1.001 \cdot 10^{+00}$	$5.226 \cdot 10^{+00}$	$1.298 \cdot 10^{+00}$	$\mathbf{7.019 \cdot 10^{-01}}$	$9.974 \cdot 10^{-01}$	$6.212 \cdot 10^{+00}$	$2.009 \cdot 10^{+00}$	$8.160 \cdot 10^{+00}$	$1.444 \cdot 10^{+01}$
z	0.05	−1	$3.300 \cdot 10^{+00}$	$4.282 \cdot 10^{+00}$	$9.353 \cdot 10^{+00}$	$3.067 \cdot 10^{+00}$	$3.244 \cdot 10^{+00}$	$3.802 \cdot 10^{+00}$	$\mathbf{2.491 \cdot 10^{+00}}$	$2.908 \cdot 10^{+00}$	$6.462 \cdot 10^{+00}$	$2.768 \cdot 10^{+00}$	$7.136 \cdot 10^{+00}$	$1.516 \cdot 10^{+01}$
z	0.05	+1	$3.467 \cdot 10^{+00}$	$7.523 \cdot 10^{+00}$	$1.526 \cdot 10^{+01}$	$2.652 \cdot 10^{+00}$	$\mathbf{1.099 \cdot 10^{+00}}$	$2.038 \cdot 10^{+00}$	$2.632 \cdot 10^{+00}$	$7.579 \cdot 10^{+00}$	$1.093 \cdot 10^{-01}$	$3.242 \cdot 10^{+00}$	$8.497 \cdot 10^{+00}$	$1.493 \cdot 10^{+01}$
z	0.10	−1	$3.168 \cdot 10^{+00}$	$4.145 \cdot 10^{+01}$	$1.023 \cdot 10^{+01}$	$3.125 \cdot 10^{+00}$	$7.048 \cdot 10^{+00}$	$5.625 \cdot 10^{+00}$	$\mathbf{2.600 \cdot 10^{+00}}$	$6.077 \cdot 10^{+00}$	$8.549 \cdot 10^{+00}$	$2.642 \cdot 10^{+00}$	$6.812 \cdot 10^{+00}$	$1.566 \cdot 10^{+01}$
z	0.10	+1	$3.086 \cdot 10^{+00}$	$7.371 \cdot 10^{+00}$	$2.101 \cdot 10^{+01}$	$\mathbf{2.584 \cdot 10^{+00}}$	$7.256 \cdot 10^{+00}$	$4.140 \cdot 10^{+00}$	$2.937 \cdot 10^{+00}$	$8.609 \cdot 10^{+00}$	$1.185 \cdot 10^{+01}$	$3.111 \cdot 10^{+00}$	$1.111 \cdot 10^{+01}$	$1.433 \cdot 10^{+01}$
z	0.15	−1	$2.833 \cdot 10^{+00}$	$8.589 \cdot 10^{+00}$	$1.035 \cdot 10^{+01}$	$3.152 \cdot 10^{+00}$	$7.622 \cdot 10^{+00}$	$8.114 \cdot 10^{+00}$	$2.891 \cdot 10^{+00}$	$9.203 \cdot 10^{+00}$	$7.411 \cdot 10^{+00}$	$\mathbf{2.738 \cdot 10^{+00}}$	$8.899 \cdot 10^{+00}$	$1.516 \cdot 10^{+01}$
z	0.15	+1	$2.602 \cdot 10^{+00}$	$8.616 \cdot 10^{+00}$	$2.571 \cdot 10^{+01}$	$\mathbf{2.519 \cdot 10^{+00}}$	$7.437 \cdot 10^{+00}$	$6.535 \cdot 10^{+00}$	$3.221 \cdot 10^{+00}$	$8.446 \cdot 10^{+00}$	$1.198 \cdot 10^{+01}$	$2.758 \cdot 10^{+00}$	$1.006 \cdot 10^{+01}$	$1.843 \cdot 10^{+01}$

Table 10: Solver configuration: We used a factor of 1 for the integration time, i.e. the integration constant is 0.002 s with a real-time control frequency of 500 Hz. Bold types of minimum values are considered experiment (i.e. row) wise.

penalty	human	rotated	standard	standard-angled
u.pen	$1.000 \cdot 10^{-01}$	$1.000 \cdot 10^{-01}$	$1.000 \cdot 10^{-01}$	$1.000 \cdot 10^{-01}$
x.pen	$5.000 \cdot 10^{+04}$	$3.000 \cdot 10^{+04}$	$5.000 \cdot 10^{+04}$	$1.000 \cdot 10^{+05}$
rot.pen	$1.000 \cdot 10^{+05}$	$3.000 \cdot 10^{+05}$	$1.000 \cdot 10^{+05}$	$6.000 \cdot 10^{+00}$
state.bound.pen	$0.000 \cdot 10^{+00}$	$0.000 \cdot 10^{+00}$	$0.000 \cdot 10^{+00}$	$0.000 \cdot 10^{+00}$
state.pen	$0.000 \cdot 10^{+00}$	$0.000 \cdot 10^{+00}$	$0.000 \cdot 10^{+00}$	$0.000 \cdot 10^{+00}$
q.pen	$1.000 \cdot 10^{-02}$	$1.000 \cdot 10^{-02}$	$1.000 \cdot 10^{-02}$	$1.000 \cdot 10^{-02}$
v.pen	$0.000 \cdot 10^{+00}$	$0.000 \cdot 10^{+00}$	$0.000 \cdot 10^{+00}$	$0.000 \cdot 10^{+00}$