

Appendix of Surface Force Data

This is an IJRR multimedia Extension. This data is for surface force measurements from the paper “Assembly and Disassembly of Magnetic Mobile Micro-Robots towards Deterministic 2-D Reconfigurable Micro-Systems” by Eric Diller, Chytra Pawashe, Steven Floyd and Metin Sitti.

Magnetic field gradients have an estimated error of 25 mT/m. Magnetic fields have an estimated error of 0.01 mT for the flat-adhesion experiments, and 0.1 mT in the other experiments.

Tables 1 and 2 give surface edge-adhesion data, Tables 3 and 4 give surface flat-adhesion data and Tables 5 and 6 give surface friction data on glass on polyurethane, respectively.

Species	$B_{ec,x}$ (mT)	$B_{ec,z}$ (mT)	$\frac{dB_{ec,z}}{dz}$ (mT/m)
MR1	1.815	8.658	1424.8
MR1	1.815	7.371	1627.6
MR1	1.815	7.254	1591.2
MR1	1.815	8.775	1534
MR2	3.63	8.658	1040
MR2	3.63	8.775	1118
MR2	3.63	13.104	1320.8
MR2	3.63	7.488	1123.2
MR3	3.63	7.02	1352
MR3	3.63	8.658	1320.8
MR3	3.63	9.009	1430
MR3	3.63	7.254	1331.2
MR4	1.21	4.914	322.4
MR4	1.21	3.51	260
MR4	1.21	3.393	254.8
MR4	1.21	3.51	291.2
MR5	1.815	2.925	254.8
MR5	1.815	3.042	218.4
MR5	1.815	3.159	234
MR5	1.815	4.68	208
MR6	1.815	2.34	364
MR6	1.815	2.457	369.2
MR6	1.815	4.212	468
MR6	1.815	4.095	452.4

Table 1: Experimental data of Mag- μ Mod to surface edge-adhesion on glass.

Species	$B_{ec,x}$ (mT)	$B_{ec,z}$ (mT)	$\frac{dB_{ec,z}}{dz}$ (mT/m)
MR1	1.815	7.0	1612
MR1	1.815	9.24	1461.2
MR1	1.815	6.78	1560
MR1	1.815	5.148	1591.2
MR2	3.6	7.83	1076.4
MR2	3.6	7.95	1081.6
MR2	3.6	8.424	1050.4
MR2	3.6	8.424	1008.8
MR3	3.6	4.867	1589.12
MR3	3.6	5.265	1305.2
MR3	3.6	4.095	1336.4
MR3	3.6	5.73	1305.2
MR4	1.21	2.34	249.6
MR4	1.21	2.808	270.4
MR4	1.21	2.925	254.8
MR4	1.21	1.755	369.2
MR5	1.815	3.15	234
MR5	1.815	2.925	234
MR5	1.815	2.22	202.8
MR5	1.815	2.808	249.6
MR6	1.815	2.457	338
MR6	1.815	2.691	327.6
MR6	1.815	2.34	322.4
MR6	1.815	1.87	364

Table 2: Experimental data of Mag- μ Mod to surface edge-adhesion on polyurethane.

Species	$B_{ec,z}$ (mT)	Species	$B_{ec,z}$ (mT)
MR1	0.9088	MR4	0.064
MR1	0.928	MR4	0.0576
MR1	0.928	MR4	0.096
MR1	0.8256	MR4	0.096
MR1	0.8768	MR4	0.0832
MR1	0.7872	MR4	0.096
MR1	0.7936	MR4	0.0576
MR1	0.7552	MR4	0.064
MR2	0.2688	MR5	0.064
MR2	0.2752	MR5	0.0768
MR2	0.2432	MR5	0.1216
MR2	0.3584	MR5	0.0768
MR2	0.4736	MR5	0.128
MR2	0.5952	MR5	0.1088
MR2	0.5056	MR5	0.0768
MR2	0.5504	MR5	0.0768
MR3	0.3648	MR4	0.0768
MR3	0.288	MR4	0.0448
MR3	0.2176	MR6	0.0896
MR3	0.1728	MR6	0.0704
MR3	0.2176	MR6	0.0832
MR3	0.224	MR6	0.096
MR3	0.2112	MR6	0.0512
MR3	0.1792	MR6	0.0448

Table 3: Experimental data of Mag- μ Mod to surface flat-adhesion on glass.

Species	$B_{ec,z}$ (mT)	Species	$B_{ec,z}$ (mT)
MR1	0.7488	MR4	0.096
MR1	0.7744	MR4	0.0576
MR1	0.9408	MR4	0.096
MR1	0.9728	MR4	0.096
MR1	0.7168	MR4	0.1024
MR1	0.6784	MR4	0.096
MR1	0.5504	MR4	0.064
MR1	0.608	MR4	0.064
MR2	0.3392	MR5	0.0448
MR2	0.3328	MR5	0.0832
MR2	0.5376	MR5	0.0896
MR2	0.5568	MR5	0.0896
MR2	0.3584	MR5	0.1152
MR2	0.352	MR5	0.1344
MR2	0.2752	MR5	0.0768
MR2	0.3008	MR5	0.0704
MR3	0.1792	MR6	0.032
MR3	0.16	MR6	0.032
MR3	0.1856	MR6	0.0704
MR3	0.1792	MR6	0.0896
MR3	0.1984	MR6	0.0832
MR3	0.2176	MR6	0.064
MR3	0.192	MR6	0.0448
MR3	0.16	MR6	0.032

Table 4: Experimental data of Mag- μ Mod to surface flat-adhesion on polyurethane.

Species	$B_{ec,x}$ (mT)	$\frac{dB_{ec,x}}{dx}$ (mT/m)	$B_{ec,z}$ (mT)	$\frac{dB_{ec,z}}{dz}$ (mT/m)
MR1	8.3538	1136.72	14.52	0
MR1	11.934	1071.2	14.52	0
MR1	14.625	1066	14.52	0
MR1	10.062	925.6	14.52	0
MR2	6.669	878.8	14.52	0
MR2	5.733	837.2	14.52	0
MR2	8.19	915.2	14.52	0
MR2	7.371	930.8	14.52	0
MR3	7.02	998.4	14.52	0
MR3	10.296	1123.2	14.52	0
MR3	9.828	1081.6	14.52	0
MR3	8.073	982.8	14.52	0
MR4	5.499	400.4	14.52	0
MR4	4.914	364	14.52	0
MR4	5.85	384.8	14.52	0
MR4	5.967	390	14.52	0
MR5	3.744	436.8	14.52	0
MR5	4.329	494	14.52	0
MR5	5.148	478.4	14.52	0
MR5	3.744	405.6	14.52	0
MR6	5.616	821.6	14.52	0
MR6	5.499	837.2	14.52	0
MR6	4.68	748.8	14.52	0
MR6	4.914	800.8	14.52	0

Table 5: Experimental data of Mag- μ Mod to friction on glass.

Species	$B_{ec,x}$ (mT)	$\frac{dB_{ec,x}}{dx}$ (mT/m)	$B_{ec,z}$ (mT)	$\frac{dB_{ec,z}}{dz}$ (mT/m)
MR1	14.157	1346.8	14.52	0
MR1	14.859	1170	14.52	0
MR1	13.806	1154.4	14.52	0
MR1	10.998	1487.2	14.52	0
MR2	7.839	972.4	14.52	0
MR2	6.669	1315.6	14.52	0
MR2	10.647	1045.2	14.52	0
MR2	8.775	1118	14.52	0
MR3	10.647	1097.2	14.52	0
MR3	12.285	1170	14.52	0
MR3	11.817	1097.2	14.52	0
MR3	10.647	1232.4	14.52	0
MR4	7.488	613.6	14.52	0
MR4	7.02	780	14.52	0
MR4	7.254	821.6	14.52	0
MR4	8.307	858	14.52	0
MR5	7.371	514.8	14.52	0
MR5	8.307	712.4	14.52	0
MR5	6.552	520	14.52	0
MR5	8.424	572	14.52	0
MR6	4.797	1128.4	14.52	0
MR6	6.669	972.4	14.52	0
MR6	5.148	956.8	14.52	0
MR6	6.435	795.6	14.52	0

Table 6: Experimental data of Mag- μ Mod to friction on polyurethane.