

Appendix A: Parameters of the system

The parameters of the ball bearing 6011 can be seen in Table A1. The parameters of the pinion, gear and spline can be seen in Table A2. The parameters of the FE model of the shafts can be seen in Table A3. The parameters of the lumped masses can be seen in Table A4.

Table A1 Parameters of the ball bearing 6011

Parameter	Value	Parameter	Value
Modulus of elasticity/GPa	207.8	Pitch diameter, d_m /mm	72.5
Poisson ratio	0.3	Curvature coefficient of inner raceway, f_i	0.515
Density/ ($\text{kg}\cdot\text{m}^{-3}$)	7800	Curvature coefficient of outer raceway, f_o	0.515
Number of balls, N_b	13	Radial clearance, $S_r/\mu\text{m}$	4
Diameter of the ball, d_b /mm	10.319		

Table A2 Parameters of the pinion, gear and spline

Parameter	Pinion	Gear	Spline	Parameter	Pinion	Gear	Spline
Modulus of elasticity/GPa	207.8	207.8	207.8	Number of teeth	35	42	12
Poisson ratio	0.3	0.3	0.3	Pressure angle/(°)	20	20	30
Density/ ($\text{kg}\cdot\text{m}^{-3}$)	7800	7800	7800	Relative azimuth angle/(°)	184	184	
Module/mm	3	3	3				

Table A3 Parameters of the FE model of shafts

Shaft number	Segment number	Length/mm	Outside diameter/mm	Inside diameter/mm
Shaft S1	1	19.000	60.000	25.000
	2	24.000	60.000	25.000
	3	14.584	50.000	25.000
	4	19.916	50.000	25.000
	5	24.710	50.000	25.000
	6	27.290	50.000	25.000
	7	15.500	50.000	25.000
	8	6.000	50.000	15.000
	9	9.000	50.000	15.000
	10	25.000	45.000	15.000
	11	16.000	45.000	15.000
	12	6.800	40.000	15.000
	13	11.200	40.000	15.000
Shaft S2	1	9.500	55.000	40.500
	2	21.500	55.000	40.500
	3	21.500	55.000	40.500
	4	21.500	55.000	40.500
	5	9.000	55.000	40.500
	6	6.260	50.000	40.500
	7	15.740	50.000	40.500
Shaft S3	1	13.500	25.000	10.000
	2	7.500	25.000	10.000
	3	18.500	31.000	0.000
	4	30.000	31.000	0.000
	5	30.000	31.000	0.000
	6	30.000	31.000	0.000

to be continued

Continued

Shaft number	Segment number	Length/mm	Outside diameter/mm	Inside diameter/mm
Shaft S3	7	9.500	31.500	0.000
	8	21.500	31.500	0.000
	9	21.500	31.500	0.000
	10	21.500	31.500	0.000
	11	15.260	31.500	0.000
	12	15.740	31.500	0.000
	13	21.500	28.500	0.000
	14	30.000	28.500	0.000
	15	30.000	28.500	0.000
	16	30.000	28.500	0.000
	17	30.000	28.500	0.000
	18	30.000	28.500	0.000
	19	30.000	28.500	0.000
	20	30.000	28.500	0.000
	21	30.000	45.000	0.000
	22	30.000	45.000	0.000
	23	30.000	45.000	29.000
	24	30.000	45.000	29.000

Table A4 Parameters of the lumped masses

Lumped mass	Mass/kg	Moment of inertia, $I_x/(\text{kg}\cdot\text{mm}^2)$	Moment of inertia, $I_y/(\text{kg}\cdot\text{mm}^2)$	Moment of inertia, $I_z/(\text{kg}\cdot\text{mm}^2)$
LM1	2.5818	3141.3519	3141.3519	5682.6558
LM2	6.0423	14831.5173	14831.5173	27817.5350
LM3	0.1217	41.1925	41.1925	80.5507
LM4	0.2158	114.9524	114.9524	225.1696
Pinion	0.9999	844.9294	844.9294	1572.2689
Gear	1.0253	1261.8295	1261.8295	2487.7132