

Musical analysis of equal-temper and harmonic intervals between planetary orbits in the Solar System

Interval	Harmonic ratio	Harmonic fre	Aspect		Semi-tones	Freq.ratio	Inverted Freq.ratio		(Cents)
Unison	1:1	1	Conjunction (0°)	Prima	0	1	1		{Semi tone multiplier =Power(2,1/12) ...}
				Secunda minor	1	1.059463	0.943874		
				Secunda	2	1.122462	0.890899		
Minor 3rd	5:6	1.200000	Sextile (60°)	Tercie minor	3	1.189207	0.840896		
Major 3rd	4:5	1.250000	Quintile (72°)	Tercie	4	1.259921	0.793701		
Perfect 4th	3:4	1.333333	Quadrature (90°)	Quarta	5	1.334840	0.749154		
	5:7, 10:7			Quinta minor	6	1.414214	0.707107		
Perfect 5th	2:3	1.500000	Trine (120°)	Quinta	7	1.498307	0.667420		
Minor 6th	5:8	1.600000	Sesquiquadrate (135°)	Sexta minor	8	1.587401	0.629961		
Major 6th	3:5	1.666667	Biquintile (144°)	Sexta	9	1.681793	0.594604		
	9:5			Septima minor	10	1.781797	0.561231		
	15:8			Septima	11	1.887749	0.529732		
Perfect Octave	1:2	2.000000	Opposition (180°)	Octava	12	2.000000	0.500000		
					13	2.118926	0.471937		
				Secunda	14	2.244924	0.445449		
					15	2.378414	0.420448		
	5:2			Tercie	16	2.519842	0.396850		
				Quarta	17	2.669680	0.374577		
	? 20:7				18	2.828427	0.353553		
	1:3			Quinta	19	2.996614	0.333710		
					20	3.174802	0.314980		
				Sexta	21	3.363586	0.297302		
					22	3.563595	0.280616		
				Septima	23	3.775497	0.264866		
	1:4			Octava	24	4.000000	0.250000		
					25	4.237852	0.235969		
				Secunda	26	4.489848	0.222725		
					27	4.756828	0.210224		
	1:5			Tercie	28	5.039684	0.198425		
				Quarta	29	5.339359	0.187288		
					30	5.656854	0.176777		
	1:6			Quinta	31	5.993228	0.166855		
					32	6.349604	0.157490		
				Sexta	33	6.727171	0.148651		
	? 1:7				34	7.127190	0.140308		
				Septima	35	7.550995	0.132433		
	1:8			Octava	36	8.000000	0.125000		
					37	8.475705	0.117984		
				Secunda	38	8.979696	0.111362		
					39	9.513657	0.105112		
				Tercie	40	10.079368	0.099213		
				Quarta	41	10.678719	0.093644		
					42	11.313708	0.088388		
				Quinta	43	11.986457	0.083427		
					44	12.699208	0.078745		
				Sexta	45	13.454343	0.074325		
					46	14.254379	0.070154		
				Septima	47	15.101989	0.066216		
				Octava	48	16.000000	0.062500		

Color legend matches colors on Resonances pag(Darker colors are more important/exact resonances)
 Each „interval“ is duplicated in higher octaves, (--shown in gray--)

Resonances

	Planet	Mercury	Venus	Earth	Mars	Asteroids	Jupiter	Saturn	Uranus	Neptune	Pluto
	(days)	87.969	224.701	365.256	686.960	1679.819	4333.287	10756.200	30707.490	60223.353	90613.310
Planet											
		Divisions of orbital periods									
Mercury	87.96934	1.00000	2.55431	4.15209	7.80908	19.09551	49.25906	122.27214	349.07036	684.59480	1030.05559
Venus	224.70069	0.39150	1.00000	1.62552	3.05722	7.47581	19.28471	47.86901	136.65953	268.01588	403.26227
Earth	365.25641	0.24084	0.61519	1.00000	1.88076	4.59901	11.86368	29.44835	84.07105	164.87966	248.08137
Mars	686.96000	0.12806	0.32709	0.53170	1.00000	2.44529	6.30792	15.65768	44.70055	87.66646	131.90478
Asteroids	1679.81900	0.05237	0.13376	0.21744	0.40895	1.00000	2.57962	6.40319	18.28024	35.85110	53.94231
Jupiter	4333.28670	0.02030	0.05185	0.08429	0.15853	0.38765	1.00000	2.48223	7.08642	13.89785	20.91099
Saturn	10756.19950	0.00818	0.02089	0.03396	0.06387	0.15617	0.40286	1.00000	2.85486	5.59894	8.42429
Uranus	30707.48960	0.00286	0.00732	0.01189	0.02237	0.05470	0.14111	0.35028	1.00000	1.96119	2.95085
Neptune	60223.35280	0.00146	0.00373	0.00607	0.01141	0.02789	0.07195	0.17861	0.50989	1.00000	1.50462
Pluto	90613.31000	0.00097	0.00248	0.00403	0.00758	0.01854	0.04782	0.11870	0.33888	0.66462	1.00000

Tercie	Jupiter/Saturn	Tercie	Venus/Mercury
Quinta Minor	Saturn/Uranus	Quinta Minor	Saturn/Neptune
Quinta Major	Venus/Mars	Quinta Major	Neptune/Pluto
Quinta Major	Jupiter/Earth	Quinta Major	Uranus/Pluto
Sexta Minor	Earth/Venus	Sexta Minor	Jupiter/Mars
Septima Minor	Jupiter/Uranus	Septima Minor	Jupiter/Neptune
Septima	Earth/Mars		
Octave	Uranus/Neptune		

Integer resonances

Format is: Count1/Count2 (MeetPointCount)

	Planet	Mercury	Venus	Earth	Mars	Asteroids	Jupiter	Saturn	Uranus	Neptune	Pluto
	(resonances)										
Planet											
		Integer ratios									
Mercury			23/9 (14)	29/7 (22)							
Venus		9/23 (14)		13/8 (5)	3/1 (2)						
Earth		7/29 (22)	8/13 (5)		15/8 (7)						
Mars			1/3 (2)	8/15 (7)							
Asteroids											
Jupiter								5/2 (3)	7/1 (6)	14/1 (13)	
Saturn							2/5 (3)		20/7 (13)	28/5	
Uranus							1/7 (6)	7/20 (13)		2/1 (1)	
Neptune							1/14 (13)	5/28	1/2 (1)		3/2 (1)
Pluto										2/3 (1)	

(Color intensity specifies importance – darker are more important)

	Planet	Mercury	Venus	Earth	Mars	Asteroids	Jupiter	Saturn	Uranus	Neptune	Pluto
	(resonance intervals)										
Planet											
		Intervals									
Mercury			(Tercie)								
Venus		(Tercie)		Sexta minor	Quinta						
Earth			Sexta minor		Septima						
Mars			Quinta	Septima			Sexta minor				
Asteroids											
Jupiter					Sexta minor			Tercie	Septima minor	Septima minor	
Saturn							Tercie		Quinta minor		
Uranus							Septima minor	Quinta minor		Octave	
Neptune							Septima minor		Octave		Quinta
Pluto										Quinta	

Resonance_Intervals

	Planet	Mercury	Venus	Earth	Mars	Asteroids	Jupiter	Saturn	Uranus	Neptune	Pluto
	(days)	87.969	224.701	365.256	686.960	1679.819	4333.287	10756.200	30707.490	60223.353	90613.310
Planet											
		Divisions of orbital periods									
Mercury	87.96934	1.00000	2.55431	4.15209	7.80908	19.09551	49.25906	122.27214	349.07036	684.59480	1030.05559
Venus	224.70069	0.39150	1.00000	1.62552	3.05722	7.47581	19.28471	47.86901	136.65953	268.01588	403.26227
Earth	365.25641	0.24084	0.61519	1.00000	1.88076	4.59901	11.86368	29.44835	84.07105	164.87966	248.08137
Mars	686.96000	0.12806	0.32709	0.53170	1.00000	2.44529	6.30792	15.65768	44.70055	87.66646	131.90478
Asteroids	1679.81900	0.05237	0.13376	0.21744	0.40895	1.00000	2.57962	6.40319	18.28024	35.85110	53.94231
Jupiter	4333.28670	0.02030	0.05185	0.08429	0.15853	0.38765	1.00000	2.48223	7.08642	13.89785	20.91099
Saturn	10756.19950	0.00818	0.02089	0.03396	0.06387	0.15617	0.40286	1.00000	2.85486	5.59894	8.42429
Uranus	30707.48960	0.00286	0.00732	0.01189	0.02237	0.05470	0.14111	0.35028	1.00000	1.96119	2.95085
Neptune	60223.35280	0.00146	0.00373	0.00607	0.01141	0.02789	0.07195	0.17861	0.50989	1.00000	1.50462
Pluto	90613.31000	0.00097	0.00248	0.00403	0.00758	0.01854	0.04782	0.11870	0.33888	0.66462	1.00000

	Planet	Mercury	Venus	Earth	Mars	Asteroids	Jupiter	Saturn	Uranus	Neptune	Pluto
	(resonances)										
Planet											
		Integer ratios									
Mercury			23/9	29/7							
Venus		9/23		13/8	3/1						
Earth		7/29	8/13		15/8						
Mars			1/3	8/15							
Asteroids											
Jupiter								5/2	7/1	14/1	
Saturn							2/5		20/7	28/5	
Uranus							1/7	7/20		2/1	
Neptune							1/14	5/28	1/2		3/2
Pluto										2/3	

Interval	Semi-tones	Harmonic interval	Harmonic Ratio
Prima	0	Unison	1:1
Secunda minor	1		
Secunda	2		
Tercie minor	3	Minor 3rd	5:6
Tercie	4	Major 3rd	5:4, 5:2
Quarta	5	Perfect 4th	3:4
Quinta minor	6		5:7, 10:7
Quinta major	7	Perfect 5th	2:3
Sexta minor	8	Minor 6th	5:8
Sexta	9	Major 6th	3:5
Septima minor	10		9:5
Septima	11		
Octava	12	Perfect Octave	1:2

(Used intervals are coloured over a whole row...)
 (Planets on the right in palette of previous page...)

This is a preliminary version of Musical Interval analysis of planet resonances and orbital ratios in the Solar system.

(Version 090828-3)

Semi, 2009

semi (at) gurroa (dot) cz

Special thanks to Steve Coleman of M-Base for a hint of harmonic resonance intervals.

Discussion:

There seems to be two similar "Octaves" (or groups) of planetes (usually divided/named as "Inner" and "Outer" planets).

The best harmonic resonance occurs at group centers, between Earth/Venus, Venus/Mercury, Saturn/Neptune and Saturn/Uranus planets.

Simple orbital periods are used for frequency ratios, while the planets really move on ellipses at different angular speeds, so the quality of actual tonal synchronization may differ over the orbit...
 (would need a dynamic calculation of angular velocity ratios to appraise the real-time harmonies?)

Resonance_Cents

Planets	Orbital Ratio	Harmonic ratio	Harmonic cents	Semi-tones	Equal-temper cents	E.-T. Interval	Avg.meet time (days/years)	Meet count
			(cent=1.00057778950655)					
Earth/Venus	1.62552	13/8	1	8	41.09	Sexta minor	583.938 1.5987	5
Venus/Mars	3.05722	3/1	33	19	34.67	Quinta	339.856 0.9305	2
Earth/Mars	1.88076	15/8	6	11	-6.42	Septima	780.451 2.1367	7
Venus/Mercury	2.55431	23/9	1	16	23.52	Tercie	144.608 0.3959	14
Earth/Mercury	4.15209	29/7	4	25	-35.4	Secunda minor	126.924 0.3475	22
			(integer value calculated by recursion)					
Jupiter/Mars	6.30792			32	-11.4	Sexta minor	0.0000	
			(exact values for equal-temper semi-tones and cents)					
Jupiter/Saturn	2.48223	5/2	-13	16	-26.04	Tercie	7227.260 19.7868	3
Saturn/Uranus	2.85486	20/7	-2	18	16.11	Quinta minor	16564.805 45.3512	13
Neptune/Uranus	1.96119	2/1 (51/26)	-34	12	-33.92	Octave	62626.188 171.4581	1 (25)
Jupiter/Uranus	7.08642	7/1	22	34	-9.93	Septima minor	5044.332 13.8104	6
Jupiter/Neptune	13.89785	14/1	-13	46	-43.85	Septima minor	4668.735 12.7821	13
Pluto/Neptune	1.50462	3/2	6	7	7.28	Quinta	60383.615 165.3184	1
Saturn/Neptune	5.59894	28/5	-1	30	-17.81	Quinta minor	13101.395 35.8690	23

Planet	Orbital (days)	Orbital (years)
Mercury	87.96934	0.24084
Venus	224.70069	0.61519
Earth	365.25641	1.00000
Mars	686.96000	1.88076
Asteroids	1679.81900	4.59901
Jupiter	4333.28670	11.86368
Saturn	10756.19950	29.44835
Uranus	30707.48960	84.07105
Neptune	60223.35280	164.87966
Pluto	90613.31000	248.08137

(Source data...)

Ratio between orbital period and pair meetpoint period

Earth/Venus	1.62552	13/8	1	8	41.09 Sexta minor	8/5 = 1.6
Earth/M(E,V)	1.59871	8/5	-2	8	12.29 Sexta minor	
Venus/M(E,V)	2.59874	13/5	-1	17	-46.63	13/5 = 2.6
Venus/Mars	3.05722	3/1	33	19	34.67 Quinta	3/2 *2 = 3
Venus/M(V,M)	1.51248	3/2	15	7	16.3 Quinta	3/2 = 1.5
Mars/M(V,M)	0.49472	1/2		-12	-18.36	
Earth/Mars	1.88076	15/8	6	11	-6.42 Septima	15/8 = 1.875
Earth/M(E,M)	0.46801			-13	-14.48	
Mars/M(E,M)	0.88021			-2	-20.9	
Venus/Mercury	2.55431	23/9	38	16	23.52 Tercie	5/2 = 2.5
Venus/M(V,M)	1.55386	14/9		8	-36.98	
Mercury/M(V,M)	0.60833	14/23		-9	39.51	
Earth/Mercury	4.15209	29/7	4	25	-35.4	
Earth/M(E,M)	2.87777	29/22		18	29.94	
Mercury/M(E,M)	0.69309			-6	-34.66	
Jupiter/Mars	6.30792			32	-11.4 Sexta minor	
Jupiter/Saturn	2.48223	5/2	-13	16	-26.04 Tercie	
Jupiter/M(J,S)	1.66785	5/3		9	-14.42	
Saturn/M(J,S)	0.67192	2/3		-7	11.62	
Saturn/Uranus	2.85486	20/7	-2	18	16.11 Quinta minor	
Saturn/M(S,U)	1.54002	20/13		7	47.54	
Uranus/M(S,U)	0.53944	7/13		-11	31.44	
Neptune/Uranus	1.96119	2/1 (51/26)	-34	12	-33.92 Octave	
Neptune/M(N,U)	1.03990	1/1		1	-32.27	
Uranus/M(N,U)	2.03944	2/1		12	33.81	
Jupiter/Uranus	7.08642	7/1	22	34	-9.93 Septima minor	
Jupiter/M(J,U)	1.16409	7/6		3	-36.96	
Uranus/M(J,U)	0.16427	1/6		-31	-27.03	
Jupiter/Neptune	13.89785	14/1	-13	46	-43.85 Septima minor	
Jupiter/M(J,N)	1.07741	14/13		1	29.08	
Neptune/M(J,N)	0.07752	1/13		-44	-27.06	
Pluto/Neptune	1.50462	3/2	6	7	7.28 Quinta	
Neptune/M(N,P)	1.00266	?? 3/3		0	4.6	
Pluto/M(N,P)	0.66639	2/3		-7	-2.68	
Saturn/Neptune	5.59894	28/5	-1	30	-17.81 Quinta minor	
Saturn/M(S,N)	1.21803	28/23		3	41.46	
Neptune/M(S,N)	0.21755	5/23		-26	-40.72	