Apparatus Competition 2019

Reuben Leatherman, Justin Dunlap, Alex Chally, and Ralf Widenhorn

Contact:

ralfw@pdx.edu

Phone: 503 725 3898

Portland State University

Department of Physics

Ralf Widenhorn

P.O. Box 751

Portland, OR 97207-0751

Sound Interference and Vibrations of a Wine Glass

Abstract

This apparatus serves to illustrate the way sound is produced by a resonating wine glass. The apparatus rotates a rubber finger against a stationary wine glass at a fixed angular speed to create a beating signal. Using two microphones to measure sound intensity, connections between beat frequency, phase, and finger rotational speed demonstrate sound interference between antinodes of the resonating wine glass.

Construction of the Apparatus

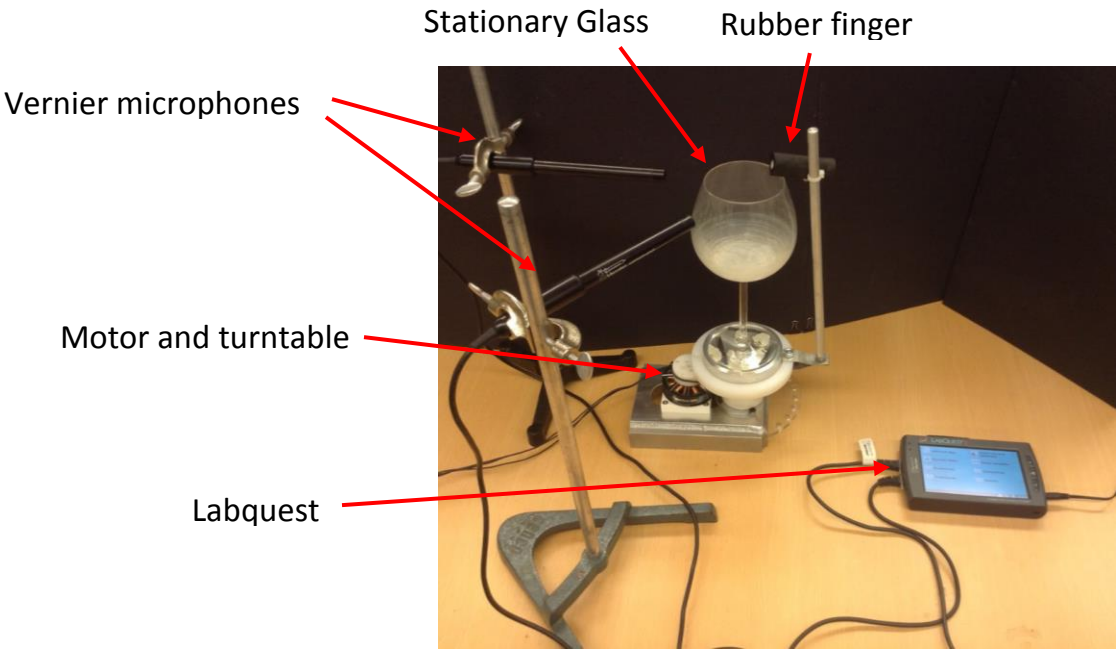
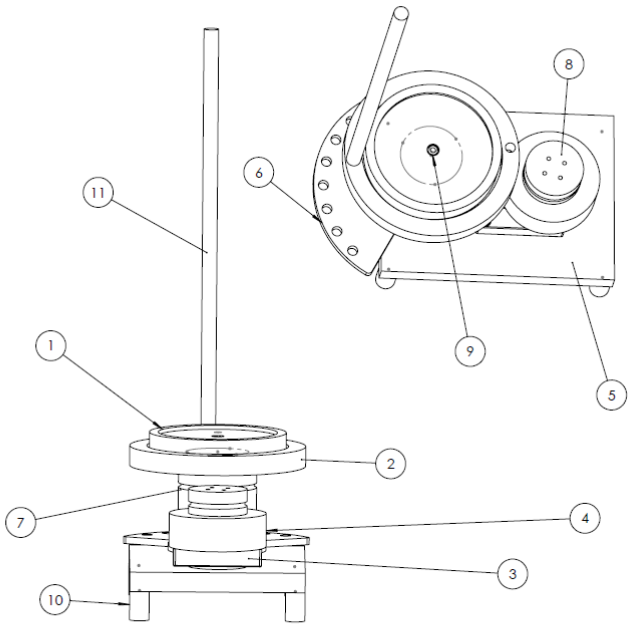


Fig 1: *The rotating finger apparatus rotates a rubber finger around the rim at a constant speed.*

Parts list

We used aluminum and arcylic for most of the apperatus:

DESCRIPTION	ITEM NO.	PART NUMBER	QTY.
3.5"X.5" Aluminum MCMaster-Carr P/N 1610T28 6" $7.28	1	platform	1
6'X6"X1/2" Delrin McMaster-Carr P/N8573K123 $13.62	2	outside platform	1
Combine this part with item #8 6"X6"X5/8" Delrin Mcmaster-Carr P/N 8573K124 $18.37	3	brushless motor mount	1
	4	brushless motor	1
6"X6"X1/2" Aluminum Mcmaster-Carr P/N 8975K219 $17.63	5	base plate	1
6"x12"X3/16" Acrylic McMaster-Carr P/N 8560K163 $6.38	6	quadrant	1
2"X2" Delrin Cut From McMaster-Carr P/N 1808T23 3.80	7	main shaft bearing holder	1
See Item #3	8	brushless motor pulley	1
1 1/4" Aluminum Rod McMaster-Carr P/N 1615T73 6" $16.85	9	shaft	1
1/2"X3/4" Rubber Cut from McMaster-Carr P/N 8695K173 6" $10.25	10	foot	4
3/8"X10 1/2" Aluminum Cut From McMaster-Carr P/N1615T65 12" $13.19	11	Rod	1



FinalAssembly A3

Additionally we used:

- Bearing ($2.38):

http://www.bearingson.com/category/radial_ball_bearings/6200_series/6200-zz_radial_ball_bearings.asp

- Motor: turnigy power systems - gimbal motor 5208 ($43.88)

https://hobbyking.com/en_us/turnigy-hd-5208-brushless-gimbal-motor-bldc.html

- RoverTec brushless gimbal motor controller BGMC2 ($49.99)

https://rovertec.com/products/bgmc2

- HJ servo consistency tester ($13.99)

https://www.amazon.com/GoolRC-Tester-Consistency-Helicopter-Airplane/dp/B00LTOD4F4

- Wine glass ($1.50)

- Battery holder ($1.86)

https://www.ledsupply.com/accessories/9v-battery-holder-switch-leads?gclid=Cj0KCQjwitPnBRCQARIsAA5n84kVivzHpl5W3HchnsVzwXqvsFh490oL6BFeRz__9Frpv7NXqID2AmcaAljuEALw_wcB

- 9V battery ($1.75)

https://www.alliedelec.com/product/energizer/en22/70145546/?gclid=Cj0KCQjwitPnBRCQARIsAA5n84lAuEDuMlJ94w860Pwk3ME6ChvydJtxROdsIgxuElsPY7sFY0ix7TgaAhiYEALw_wcB&gclsrc=aw.ds

- Adhesive putty ($1.60)

https://www.amazon.com/Scotch-MMM860-Adhesive-Putty/dp/B004P3MB7I/ref=pd_lpo_vtph_21_lp_t_3?_encoding=UTF8&psc=1&refRID=78QT8ZSQW2G2A3ZEEJ30

To measure the sound one can use for example two Vernier Microphones and a Vernier LabQuest 2.

Use of the Apparatus

The apparatus consists of a wine glass mounted to a platform, with a rod connected to a rubber finger moved by a rotating turntable beneath. Two microphones can be positioned pointing towards the center of the glass, in the plane of the glass rim, with an angle of either 45 or 90 degrees between them. The apparatus rotates the rubber finger around the rim of a stationary glass at a constant speed that can be recorded with a stopwatch. As the rubber finger runs along the moistened glass rim, the tone produced can be recorded by the two microphones. The resultant waveform can then be put through a Fast Fourier Transform to observe constituent frequencies. The sound intensity waveforms exhibit beating patterns – the phase of which depends upon the relative angular offset between the two microphones. An angle of 90 degrees corresponds to a beat phase difference of 0, whereas an angle of 45 degrees corresponds to a beat phase difference of $\pi/2$. Students use this sound this sound intensity data and its Fourier spectra to draw connections between beating, standing waves, and sound interference.