

NESS Brass - Tutorial Read Me

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Overview

This document gives a description of each tutorial file for the NESS Brass Code. There are two folders with tutorials, Beginner and Advanced. In each of these folders there are instrument files and score files. The name of the score file suggests the instrument to use, for example, combine `Advanced1_trumpet.m` with `trumpet.m`. The folders also include the output file; in the previous example, the output file is `Advanced1_trumpet.wav`

Beginner

These are the files in the Beginner folder.

Tutorial 1 - Find note

When starting with a new instrument, it is useful to set *lip_frequency* to sweep over a large frequency range to find the instrument's resonances. You can then try to narrow the range to find individual lip frequencies that work. In this example, the lip frequency is set so that at the beginning, $t = 0$ s, the lip frequency is 400Hz. It is then linearly increased so that at $t = 2$ s it is at 1000Hz.

Tutorial 2 - Play note

When you know the frequency range the lips lock to you can then try single frequencies to get a note. However, the frequency of the lips does not exactly equal the frequency of the output sound and an increase or decrease in *lip_frequency* does not offer the same increase or decrease in the output frequency. This takes some trial and error to get an in tune note. Try changing the value of the lip frequency in the score. A lip frequency of 500Hz gives an output of 552Hz, a lip frequency of 510Hz produces an output of 554Hz, and a lip frequency of 520Hz gives an output of frequency 556Hz.

Tutorial 3 - Adjust mouth pressure ramp

Usually, to get a clean attack on a note, you need some kind short ramp in the mouth pressure. This is done by having a pressure starting at 0Pa and increasing to fixed value over a finite time (rather than starting exactly at that value). However, sometimes a note, usually in the lower register, can take a while to build up to a steady sound. This can sometimes be adjusted by using a shorter pressure ramp or increasing the mouth pressure. Try adjusting the mouth pressure and the amount of time it takes to reach that pressure in the score file. Make sure the pressure starts at 0 at time 0. Try:

- at $t = 10e - 3s$, pressure is $5e3Pa$. The note takes 0.3s to start
- at $t = 10e - 4s$, pressure is $5e3Pa$. The note takes 0.25s to start
- at $t = 10e - 3s$, pressure is $8e3Pa$. The note takes 0.2s to start

You should hear the attack change for each example. The e notation is just representing powers of 10 so that $5e3 = 5 \times 10^3$.

Tutorial 4 - Pressure swell

The mouth pressure can be modified to change the volume of the output to create crescendo and diminuendo effects. In this score, the pressure includes the ramp (see previous tutorial). It then slowly increases to a value of $3e4Pa$ at $t = 1.5s$ which creates a crescendo. The diminuendo happens over the next half of the example as the pressure goes down to $3e2Pa$ at $t = 3s$.

Tutorial 5 - Slur

Phrases can be constructed by changing the lip frequency. To avoid a glissando sound, you need to tell the score to stay at one lip frequency over the duration of the note and then change the lip frequency over a short time period; around 0.1s usually works. In this example, the lip frequency is held at 500Hz for 0.9s and quickly changed to 1000Hz over a period of 0.1s to change the pitch of the note. This note is held and then at $t = 2s$, the lip frequency goes down to 200Hz over the period of 1s which creates more of a glissando.

Tutorial 6 - Separated notes

You can separate notes by setting a pressure ramp to zero at the end of the note. In this example, 3 0.5s long notes are played. The mouth pressure for each note ramps from 0Pa to $3e3Pa$ over 0.0001s, then holds the notes before ramping back down to 0Pa over 0.05s.

Tutorial 7 - Vibrato

Vibrato can be added to a note to modulate pitch. This is done by multiplying the lip frequency by a raised cosine function. The frequency and amplitude of vibrato can vary in time and are controlled the same way as lip frequency and mouth pressure—they can vary with time. The amplitude parameter denotes a fraction of the lip frequency; a vibamp value of 0.05 applied to a lip frequency

of 500Hz means the lip frequency varies between 475Hz and 525Hz. In this example, the vibrato is added to the second half of the note. You can do rapid transitions of vibrato the same way you change a note with the lip frequency. Here, the vibrato amplitude (vibamp) and frequency (vibfreq) are held at 0 for 0.99s. Over 0.01s, the vibrato amplitude then goes to 0.05 and the vibrato frequency goes to 7Hz. A more natural vibrato would use a smaller amplitude and frequency and would also vary over time.

Tutorial 8 - Tremolo

Tremolo can also be added to the note and modifies the mouth pressure the same way as the vibrato modifies the lip frequency. Here, the tremolo is only applied to the second half of the note, with a tremolo frequency (tremfreq) of 10Hz and amplitude (tremamp) of 1. The tremolo amplitude is a fraction of the mouth pressure; a value of 1 for a mouth pressure of 3e3Pa ranges from 0Pa to 6e3Pa.

Tutorial 9 - Noise

Noise can be added to the mouth pressure to mimic turbulence that naturally occurs in playing. This adds a random noise signal to the mouth pressure, where the value of noise is a fraction of the mouth pressure (like tremamp).

Tutorial 10 - Valve changes

Valves can be opened and closed to change the resonances of the instrument. Here, the lip frequency is repeatedly swept from 220Hz to 600Hz over 2s for different valve configurations. At the beginning of each sweep the valveopening parameter is changed. In this case, a three valved trumpet is used so at each time instance in valveopening, each valve must have a specified value - 1 being open (going through the default path) and 0 being closed (going through the bypass piece of tubing).

Tutorial 11 - Valve transitions

Valves can be opened and closed whilst keeping lip frequency constant to change output sound. This can make the note go up or down in pitch depending on the lip frequency and how the resonances change over time. In this case, the lip frequency is held at 330Hz whilst valves are opened and closed.

Tutorial 12 - Valve multiphonics

Multiphonic timbres can be achieved by using partial valve configurations. Here, each valve is partially open.

Tutorial 13 - Valve vibrato

Valve opening can be modulated in the same way as the lip frequency vibrato and the mouth pressure tremolo by adding a cosine function to the signal. valve vibrato is added after 1s to the note with amplitude (valvevibamp) 0.5

with a modulation frequency (valvevibfreq) of 1.5Hz. This control is the same as moving a finger up and down on a valve to open and close it. Note the amplitude for the valve vibrato is not a fraction of the valve opening this time, it is added to the valve opening; a valve vibrato amplitude of 0.5 added to a valve opening of 0.5 means that the valve opening goes from 0 to 1 (it would be clipped to these values if it went outside them also).

Advanced

Advanced 1 - Phrase

This creates a phrase by varying the lip frequency. Vibrato is added half way through the third note followed by a slow valve transition to create a multiphonic timbre

Advanced 2 - Bulgy

This uses the trumpet with a bulge in it. The sound starts with all three valves partially open and then sets them oscillating at different frequencies and amplitudes in a staggered manner.

Advanced 3 - Single valve

This uses the single valved trombone. Notice that in the instrument file only 1 value is given for vpos, vdl and vbl and correspondingly in the score file the valve parameters only have a time entry and a single valve opening value at each entry.

The note changes are given by introducing vibrato to the lip frequency and the valve openings and there is also a crescendo given in the mouth pressure.

Advanced 4 - Bassy 1

This uses the 10 m long instrument which has very low frequency resonances. The lip frequencies in this example are below 130 Hz and the note changes are made by sweeping the lip frequency and modulating the valves.

Advanced 5- Bassy 2

This also uses the 10 m long instrument. In this case vibrato is added to the lip frequency.