SONICARTSRESEARCHCENTRE

VASBPI User Manual

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1 Introduction with change

VASPBI is based on a physical model that simulates the vibrations of a string and a rectangular plate, coupled with a (nonlinear) spring-mass element. The virtual-acoustic string-plate affords new possibilities and freedom regarding parameter choices and on-line changes that are not possible (or very expensive to realise) in real-world instruments.

This study aims to gather preliminary information about the way musicians would go about exploring the parameter space of the string-plate model.

The results will inform the further design of the instrument.

2 Installation

To install the VASBPI Plug-In, just follow the instructions below, according to the platform and plug-in format you want to use.

Mac OSX VST:
Copy the vasbpi.vst bundle at the path: /Library/Audio/Plug-Ins/VST/

Mac OSX AU:
Copy the vaspbi.component bundle at the path: /Library/Audio/Plug-Ins/Components/

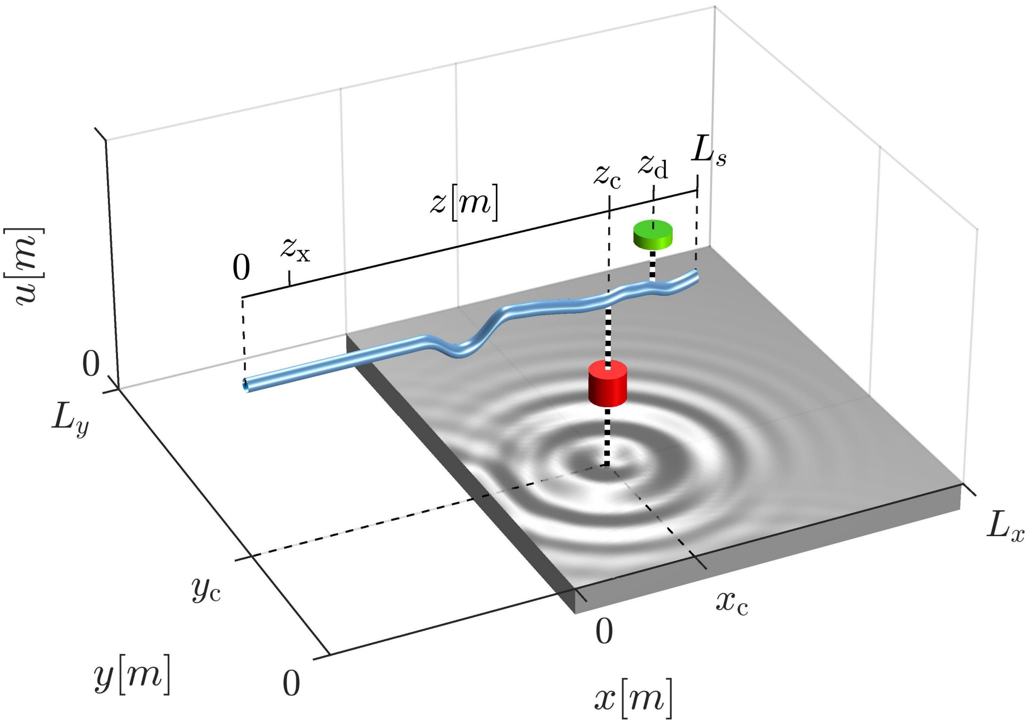
After installing the plug-ins, you should (re)start your favourite VST/AU host, making sure it rescans your Plug-Ins folder(s) to recognize VASBPI as a new Plug-In (please note that some hosts may not re-scan the plug-in folder automatically at every start-up, so you may need to do it manually. Refer to your host's manual for instructions). If everything is right, you should now see the VASBPI entry into the Plug-Ins list of your host.

3 Minimum System Requirements

Mac:
Mac OSX 10.10 or higher
Intel processor with AVX2 instructions support
8 GB RAM

4 System Description

The system takes the form of a string and a plate connected by a parameterised bridge element, with a local damper fitted on the string. The bridge can be parametrically configured to simulate different types of linear and nonlinear coupling, including mass-like behaviour, spring stiffening and contact phenomena (i.e. rattling and buzzing). For detailed information please refer to DAFX17 paper.



5 Resetting The System

WARNING!

VASPBI is still in development stage, meaning occasionally it can blow up resulting sudden audio bursts. To prevent from occurring it, the following steps were taken: a limiter is built in at the audio output, reset of the system was added and `z_connection`, `x_connection` and `y_connection` cannot be changed online. To reset the system, `Input` should be turned down to `0`. It will reset the nonlinear solver, the state modes and the output to zero, stopping further audio bursts and crashes of the system. After the reset, the system is stable again without restarting the VST/AU host.

6 Changing the Coupling Positions

You will notice, that parameter `z_connection`, `x_connection` and `y_connection` cannot be changed online. To change the coupling position on the string and the plate `Input` has to be set to `0`. When the input parameters are turned up again, the new coupling positions will be used.

7 Parameter Guide

7.1 String Parameter Controls

PARAMETER	NAME	RANGE
fundamental frequency	FundFreqString	4 – 500 Hz
inharmonicity	Inharmonicity	$10^{-8} - 10^{-3}$
damping (all frequencies)	Sigma0String	0.4 – 30
damping (frequency – dependent)	Sigma1String	$10^{-5} - 1$
damping (high frequency)	Sigma3String	$10^{-7} - 10^{-4}$
coupling position	z_connection	0 – 1
excitation position	z_excitation	0 – 1
damper position	z_damper	0 – 1

`Sigma1String` is effected in the third-order polynomial form $\sigma(\omega) = \sigma_0 + \sigma_1 (\omega/c) + \sigma_3 (\omega/c)^3$. In other words, the damping increases with frequency according to σ_1 and σ_3, while σ_0 adds an overall damping level. Setting these parameters can be thought of as controlling the (frequency-dependent) 'reverberation time' of the string.

7.2 Plate Parameter Controls

PARAMETER	NAME	RANGE
fundamental frequency	`FundFreqPlate`	10 – 130 Hz
dimensional ratio	`Rxy`	0.1 – 1
modal mass ratio	`Rps`	1 – 1000
damping (all frequencies)*	`Sigma0Plate`	0.4 – 30
damping (frequency – dependent)	`Sigma1Plate`	10^{-5} – 1
damping (high frequency)	`Sigma3Plate`	10^{-7} – 10^{-4}
connection position (X)	`x_connection`	0 – 1
connection position (Y)	`y_connection`	0 – 1
1st pick-up position (X)	`x1_audio`	0 – 1
1st pick-up position (Y)	`y1_audio`	0 – 1
2nd pick-up position (X)	`x2_audio`	0 – 1
2nd pick-up position (Y)	`y2_audio`	0 – 1

Sigma1Plate is effected in the third-order polynomial form $\sigma(\omega) = \sigma_0 + \sigma_1 (\omega/c) + \sigma_3 (\omega/c)^3$. In other words, the damping increases with frequency according to σ_1 and σ_3, while σ_0 adds an overall damping level. Setting these parameters can be thought of as controlling the (frequency-dependent) 'reverberation time' of the string.

Rxy controls the shape of the plate. `Rxy` at `1` results a square shaped plate, at `0.1` is bar shaped. `Rxy` is calculated: $R_{xy} = L_x/L_y$.

Rps controls the level of coupling between the plate and the string mass. For maximum coupling, `Rps` should be set to around unity. `Rxy` is calculated: $R_{ps} = m_p/m_s$.

7.3 Bridge Parameter Controls

PARAMETER	NAME	RANGE
modal mass ratio	Rbs	10^{-4} – 10
damping	zeta_bridge	0.01 – 50
stiffness	k_bridge	10^{-7} – 0.52
nonlinearity	eta_bridge	0 – 1
nonlinearity exponent	alpha_bridge	1 – 3
spring pull level	G1m_bridge	0 – 1
spring pull level	G2m_bridge	0 – 1

Rbs controls the level of coupling between the bridge and the string mass. Rbs is calculated: $R_{bs} = m_b/m_s$

k_bridge controls the overall bridge stiffness. Lower value results more flexible springs,stiff springs can be achieved with higher value.

eta_bridge controls the nonlinear behaviour of the springs. Lower value results more linear springs, fully nonlinear springs can be achieved at eta_bridge = 1.

alpha_bridge shapes the nonlinearty curve. At alpha_bridge = 0 is linear. Higher value results a more nonlinear curve.

G1m_bridge and **G1m_bridge** determine whether the springs are attached or detached to the mass. At 0 the springs are fully detached and at 1 the springs are fully attached to the mass.

7.4 Level Parameter Controls

PARAMETER	NAME	RANGE
input gain	Input	0 – 10
output gain	PlateGain	0 – 100
plate intput gain	InputPlate	0 – 10
string output gain	StringGain	0 – 100