

Single gesture multi-effect

Course main assignment

Description

Design and implement (in C++) a multi-effect of which multiple effect parameters can be controlled by one overarching parameter, thus via a ‘single gesture’.

Within this project you can either focus on the creation of:

- a realtime **multi-effect audio plugin that can be controlled by only one knob** (PLUGIN FOCUS), or;
- a realtime **multi-effect console application that can be controlled through OSC by one ‘gesture’ with a ready-made controller over OSC** in the real world (PLUG&PLAY FOCUS).
- a realtime **multi-effect console application that can be controlled through OSC by one ‘gesture’ with a custom-made controller over OSC** in the real world (CUSTOM FOCUS).

The latter, the CUSTOM FOCUS, requires a custom design. In other words, simply mapping an existing controller like a mouse or midi-controller is not sufficient for the CUSTOM FOCUS.

Noteworthy, due to the three offered options regarding design focus, the differences in deliverables and requirements for the PLUGIN FOCUS, PLUG&PLAY FOCUS and CUSTOM FOCUS are specified separately below.

Deliverables

Deliverables are submitted to an online git repository.

- **Overall design**

An overall description of the multi-effect (two paragraphs), which should be informative regarding:

- The chosen focus (PLUGIN FOCUS / PLUG&PLAY FOCUS / CUSTOM FOCUS) and short explanation of your choice.
- An overall description of the (proposed) effects in your multi-effect, together with a reasoning behind your selection.
- A description and justification of the mapping of the one overarching parameter into multiple parameters (can be combined with the block diagram, see further below).
- PLUG&PLAY FOCUS - Short description of the chosen ready-made controller and its interaction.
- CUSTOM FOCUS - Thorough interaction design document of the customly designed controller.

- **Diagrams**
 - Block diagrams, one for each implemented effect
 - Overall block diagram displaying the effect chain together with the mapping of the one overarching parameter into multiple parameters.
 - PLUG&PLAY FOCUS & CUSTOM FOCUS - flow / block diagram of the controller interaction and the mapping to one parameter.
 - A basic **class diagram**, displaying inheritance and association relationships between classes

- **Process description**
 - Brief description of the design process of the multi-effect and mapping, including the associated design choices
 - PLUG&PLAY FOCUS - Very brief description of the design process of the mapping of the ready-made controller to one parameter, including the associated design choices.
 - CUSTOM FOCUS - Brief description of the design process of the custom controller, including the associated design choices.

- **Codebase**

- **Selected learning objectives and reflection**, a one page document (+/- 400 a 600 words) describing:
 - The three **selected learning objectives**, provided with a **reflection** per learning goal
 - **Overall reflection**, covering:
 - The design and implementation (*e.g. proud about, possible improvements, etc.*)
 - Learned knowledge/skills (*beyond the selected learning objectives*)
 - Process (*e.g. remarkably good planning, struggles*)
 - Reflection transformed into **at least two take-aways**, relevant for the upcoming course

Requirements

Apart from the generic requirements, which can be found in the CSD git repository (“*beoordelingscriteria.pdf*” covering topics like *input validation*, *an executable* and ‘*sounding*’ application), the implementation should meet the following requirements:

- The customly designed and self-implemented final artefact consists of a realtime **multi-effect**
 - PLUGIN FOCUS: ... audio plugin that can be controlled by only one knob , or;
 - PLUG&PLAY FOCUS: ... console application that can be controlled through OSC by one ‘gesture’ interaction with a ready-made controller.
 - CUSTOM FOCUS: ... console application that can be controlled through OSC by one ‘gesture’ interaction with a custom-designed and custom-built controller.

- See **Effect implementation difficulty**. The multi-effect consists of at least **three custom-made effects** that **together yield a difficulty level** of at least
 - PLUGIN FOCUS: **six** points
 - PLUG & PLAY FOCUS: **five** points
 - CUSTOM FOCUS: **three** points
- OOP is correctly applied.

Assessment specific criteria

Apart from the generic assessment criteria, which can be found in the CSD git repository (“*beoordelingscriteria.pdf* covering topics like clear naming and comments) the assessment this course will cover:

- Presentation
 - Realtime demonstration of the final artefact.
 - Chosen focus and the custom design.
 - Reflection and take-aways
- Design
 - Justification of the design choices made with respect to the effect selection and the mapping.
- Documentation
 - Readability and clarity of the required documents
- Codebase
 - OOP
 - DSP effects correctly implemented
 - Clear and correct mapping overarching parameter to separate effect parameters.
 - Code flow is concise; no redundant function calls / lines
 - *Good practice* regarding naming, comments, style,
- Reflection
 - Coverage of the required elements
 - Readability and clarity

Effect implementation difficulty

The **marked effects** are part of the course code examples. The associated level of difficulty does not count towards the total difficulty level of your multi-effect implementation. A multi-effect that combines the following effects counts for five difficulty level points.

- Waveshaper with wavetable (1)

- Chorus (1)
- Bitcrusher (1)
- Noise Gate (2)

Effect Category	Effect	Utilizes	Implementation difficulty
filter	Biquad Filter		4
	Moog Ladder Filter		3
	State Variable Filter		4
	Onepole / RC filter		1
	All Pass Filter	Delay / Biquad	4
	Brick Wall Filter	FFT	Not Allowed
	Butterworth Filter	Biquad	3
	Linkwitz-Riley Filter	Biquad	3
Delay	Feedback Delay ($=^{\wedge}$ Comb Filter)	(circular buffer)	2
	Chorus	Delay, Oscillator	1
	Vibrato	Delay, Oscillator	1
	Flanger	Delay, Oscillator	1
	Doppler effect (basics only)	Delay	2
	Grain delay	(circular buffer)	3
	Pitch Shifter	(circular buffer)	2
	Sampler	(circular buffer)	3
Reverb	Plate	All Pass Filter	4
	Convolution	FFT	Not Allowed
	Room	All Pass Filter	5

	Bucket Brigade	Delay	4
	Datorro	All Pass Filter	2
	Griesinger	All Pass Filter	3
	Shimmer	All Pass Filter	4
Dynamics	Bit crusher		1
	Noise gate	Delay	2
	Limiter		
	De-esser	Delay, High pass	2
	Compressor, simple	Delay	2
	Compressor, advanced		5
	Waveshaper without wavetable		1
	Waveshaper with wavetable (linear interpolation required)	Waveshaper without wavetable, wavetable	1
Misc.	Tremolo		1
	LFO-based auto-panner		1
	Ringmodulator		1
	Phaser	All Pass Filter	3
	Disperser	All Pass Filter	2
	Multiband ____	Linkwitz-Riley / Or other	3
	Phase vocoder	Short-time FT	Not Allowed