Introducing Gamut, a D image library

A long-term goal for the Dplug library.

Meeting
Aug 23th 2022

(Dplug news)

- Dplug “winter” is nearly over, since Auburn Sounds next plug-in is ready => 6th September
- That means: bug fixes and enhancements for the next six months.
- DConf 2022 happened.

The context

dplug:graphics is all based upon a forked ae.utils.graphics

- Was presented in https://blog.cy.md/2014/03/21/functional-image-processing-in-d/
- Groundbreaking article, served us well (draw ellipses in L16 and RGBA8 with the same code!)
- Top speed.

I used and forked this in 2015 as I thought it would be easy for you peeps to understand.

Early widgets were complicated to draw

```
    croppedRaw.aaSoftDisc(projected.x - dirtyRect.min.x, projected.y - dirtyRect.min.y, 0, radiusScale * 20, diffu
    croppedRaw.aaSoftCircle(projected.x - dirtyRect.min.x, projected.y - dirtyRect.min.y,
                            radiusOutputLevel - 2, radiusOutputLevel, radiusOutputLevel + 2, diffusePotential, 0.5
    croppedRaw.aaSoftDisc(projected.x - dirtyRect.min.x, projected.y - dirtyRect.min.y, 3 * _S - 2, 3 * _S, diffus
}
```

…before the smaller **`dplug:canvas`** API became the preferred way to draw widgets.

Therefore, marginalizing the older style of writing to “Voldemort” lazy image chains.

But actually we need something like Cairo

- This kind of open-ended API is best when you don't know what you will need to compute.
- Plenty of `OwnedImage!RGBA`, `ImageRef!RGBA`, `toRef()`, templates…
- **Templates are inherently public and lead to large API surface** => bad for learning.
- Pretty sure `dplug:graphics` is confusing for new and ancient D programmers.
- I've fought to make easy things easier in Dplug, and that means *less* powerful.

Let's follow the hugely simplifying example of `dplug:canvas` !

Next step: remake the image basics

- dplug:graphics has pretty good image-loading (fast, low memory, best 4:2:0 quality) in pure D.
  - Important to be able to load and convert to another number of channels at the same time.
  - 16-bit support important for PBR (our “depth” is a “displacement map” in video games parlance).
- dplug:graphics has best image resizing in pure D (fast, low memory, quality)
  - Basically `stb_image_resize.d` with better kernels (lanczos)
- Make that available to the larger community.
- Plenty of small refactoring steps, will take years.

No more of that

- No more *pixel type* like `!RGBA` : this is a runtime type.

- No more `ImageRef` vs `OwnedImage` : there is only a single `Image` type
  - Able to do both
  - Own its data, or borrow it
  - Advanced layout options to replace `OwnedImage` completely.

- One `Image` type to Rule Them All

Adding exotic codecs

- **QOI**, lossless codec invented by Dominic Szablewski, faster than PNG and in some cases smaller (typically: large transparent overlays). See https://qoiformat.org/
  Already supported today in Dplug (use the image converter in Gamut).

Adding more exotic codecs

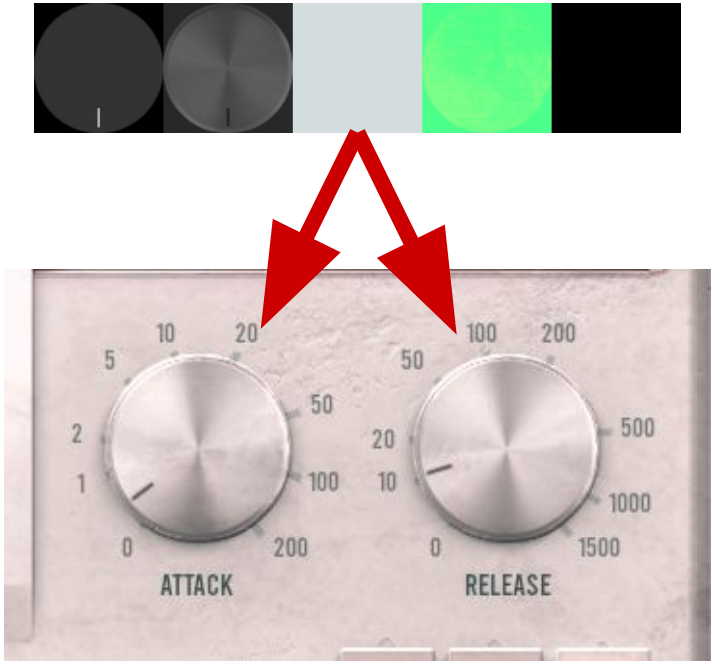
- **QOIX**, a Gamut-specific custom format *(no fixed bitstream as of today Aug 2022)*
  - *uses a better compression scheme than regular QOI (at least QOI2AVG)*
  - *followed by LZ4 compression*
  - Is made of *3 different sub-codecs:* QOI2AVG, QOI-Plane, QOI-10b… most good ideas came from people creating QOI2AVG in https://github.com/nigeltao/qoi2-bikeshed
  - Supports 1/2/3/4 channels in 8-bit and 10-bit.

- In most cases, QOIX win against PNG in decoding speed, memory usage.
  - and in some cases in coding efficiency.
  - QOIX 10-bit is lossy, so it “wins” much more often against expensive 16-bit PNG.
  - QOIX is always smaller than QOI.

- The main usage of QOIX will be 16-bit PBR knobs in Issue #457 (renovating ImageKnob) Otherwise, each knob may take 200kb).
  - *At which point, we will have rotating PBR knobs with proper depth, enabling very pretty knobs.*

Example 1: 8-bit image knob

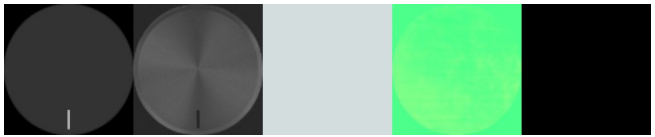
Consider this
`UIImageKnob`
used as Attack knob
in Renegate plug-in.



Example 1: 8-bit image knob

800 x 550 8-bit knob image.

- as 16-bit PNG => 94.2 kb
- as 10-bit QOIX => 90.6 kb
- as 8-bit PNG => 75.6 kb
- as 8-bit QOIX => 70.3 kb



Decodes in 1.05 ms instead of 2.67 ms *(8-bit, see examples/qoix in Gamut repo).*
Encodes 10x faster than PNG.

Example 2: 8-bit transparent overlay

This 800 x 550 8-bit overlay in Auburn Sounds next plugin:

- as 16-bit PNG => 1343 kb (!)
- as 10-bit QOIX => 441 kb
- as 8-bit PNG => 156 kb
- as 8-bit QOIX => 174 kb
- as 8-bit QOI => 252 kb

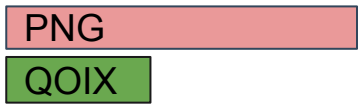
Likewise, faster encoding and decoding in QOIX. (QOI is even faster).

Mystery plug-in to be released September 6th

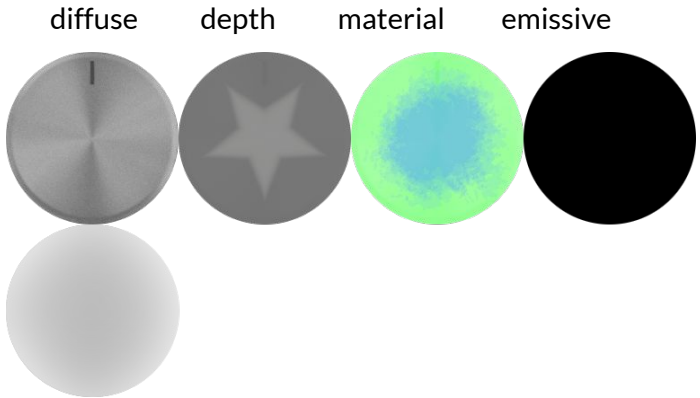
Example 3: 10-bit UIImageKnob of the future

This 768 x 384 10-bit knob will enable better textured rotating knobs.

- as 16-bit PNG => 467 kb
- as 10-bit QOIX => 193 kb (lossy!)



Also, faster encoding and decoding in QOIX.



The future ***`UIImageKnob`*** *format.*
Row 1 = Rotating Diffuse / Depth / Material / Emissive
Row 2 = Same but without rotation.
TODO: do something for clicked/hovered/focused/disabled.

The hope is that 10-bit is enough for elevation.

Future endeavours?

- **Actually finish Gamut and start using it in Dplug.**
- (Why not) Keeping QOI-encoded backgrounds in memory instead of decoding them from JPG on resize.
- (Why not) Programmatic screenshots.

Questions?