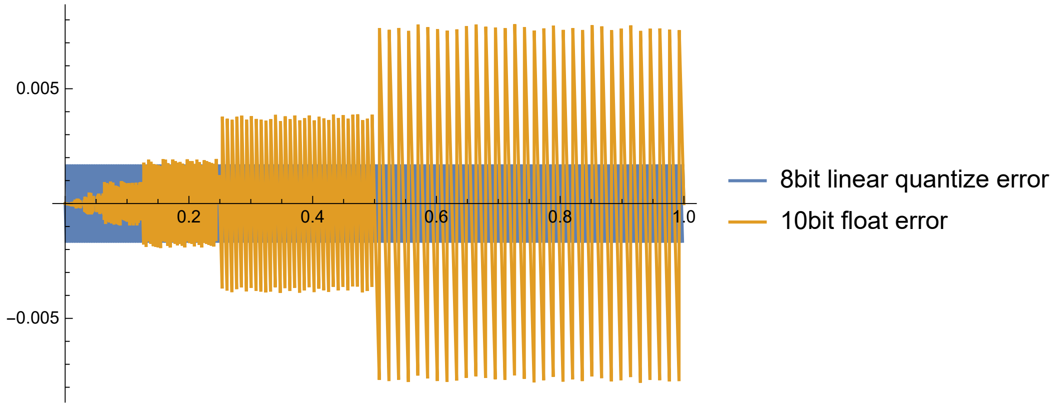
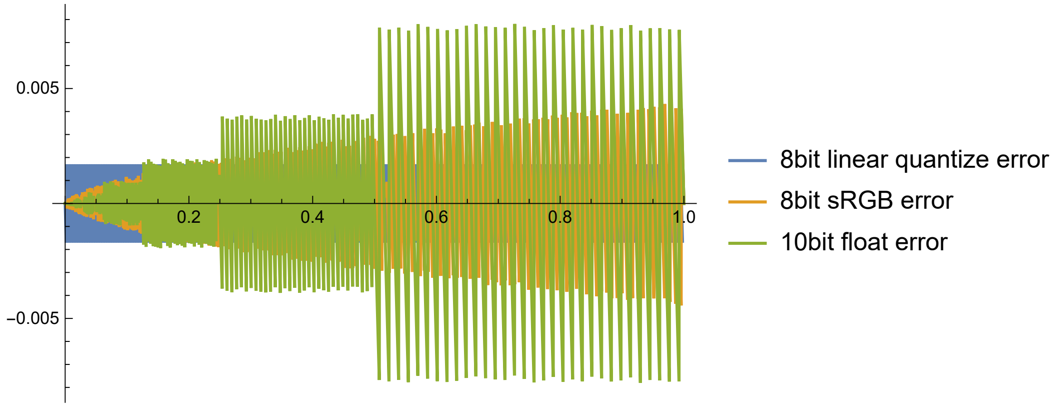
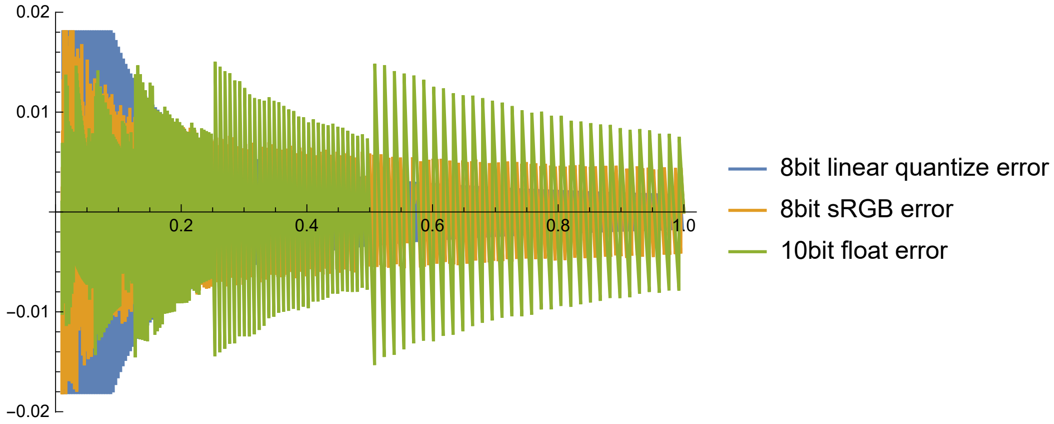
```
(* Some helper functions *)
linearToSrgb[x_] := If[x < 0.0031308, 12.92 * x, (1 + 0.055) * Power[x, 1 / 2.4] - 0.055]
srgbToLinear[x_] := If[x < 0.04045, x / 12.92, Power[((x + 0.055) / (1 + 0.055)), 2.4]]
eightBitSrgb[x_] := srgbToLinear[Round[linearToSrgb[x] * 255] / 255]
eightBit[x_] := Round[x * 255] / 255
tenBit[x_] := Round[x * 1023] / 1023


(* Extra helpers to get float representations in Mathematica,
source http://community.wolfram.com/groups/-/m/t/274061 by Yu(u)ki IWABUCHI *)

(*convert to IEEE 754 single precision floating point binary
 seqence (length:32) from number*)real32Digits[x_] := IntegerDigits[
  First[ImportString[ExportString[x, "Real32"], "UnsignedInteger32"]], 2, 32]

(*generate {Sign,Exp,Mantissa} list from
 Real 32 binary sequence (except special number)*)
real32Format[li_] := {If[First[li] === 0, 1, -1], FromDigits[Take[li, {2, 9}], 2] - 2^7 + 1,
  FromDigits[{Join[{1}, Take[li, {10, 32}]], 1}, 2]}

(*convert to real number from Real32 binary sequence*)
fromReal32Digits[li_] :=
 First[ImportString[ExportString[FromDigits[li, 2], "UnsignedInteger32"], "Real32"]]

(*simple and dirty zeroing of bits in binary digit list*)
zeroBits[x_, n_] := Module[{l = Length[x]}, ReplacePart[x, # → 0 & /@ Range[l - n + 1, l]]]
(*simple and dirty binary round up*)
binaryRound[x_, n_] :=
 zeroBits[IntegerDigits[FromDigits[x, 2] + BitShiftLeft[1, n - 1], 2], n]

(*Visualize error of 10bit float vs 8bit linear RGB value*)
Plot[{eightBit[x] - x, fromReal32Digits[binaryRound[real32Digits[x], 18]] - x},
 {x, 0, 1}, PlotLegends → {"8bit linear quantize error", "10bit float error"}]
```



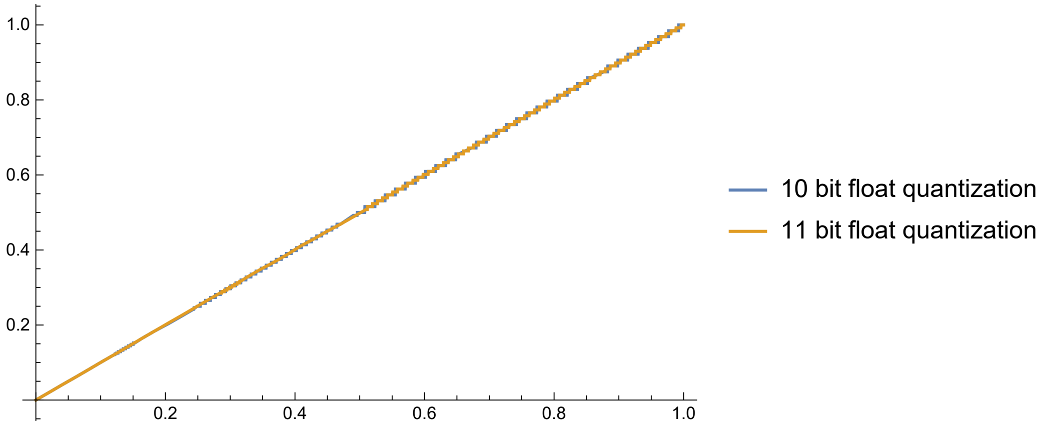
```
(*Visualize error of 10bit float vs 8bit linear RGB value vs 8bit sRGB*)
Plot[{eightBit[x] - x, eightBitSrgb[x] - x,
  fromReal32Digits[binaryRound[real32Digits[x], 18]] - x}, {x, 0, 1},
 PlotLegends → {"8bit linear quantize error", "8bit sRGB error", "10bit float error"}]
```



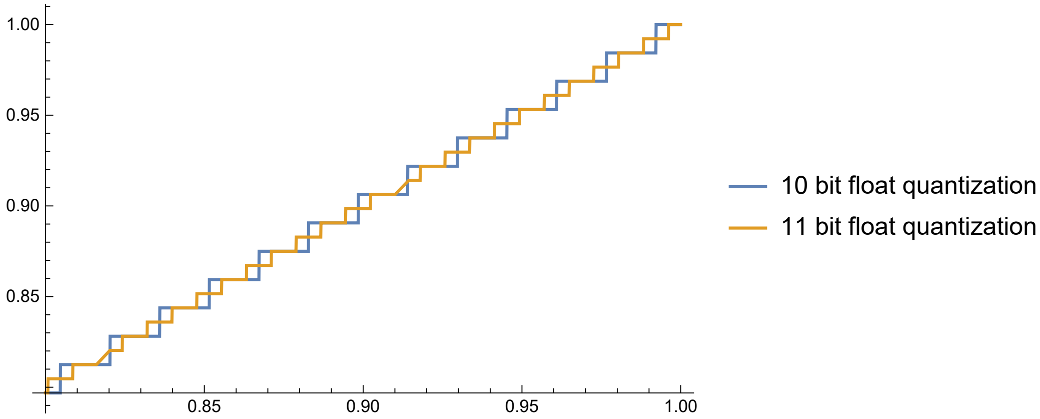
```
(*Visualize relative error of 10bit float vs 8bit linear RGB value vs 8bit sRGB*)
Plot[{(eightBit[x] - x) / x, (eightBitSrgb[x] - x) / x,
  (fromReal32Digits[binaryRound[real32Digits[x], 18]] - x) / x}, {x, 0.01, 1},
 PlotLegends → {"8bit linear quantize error", "8bit sRGB error", "10bit float error"}]
```



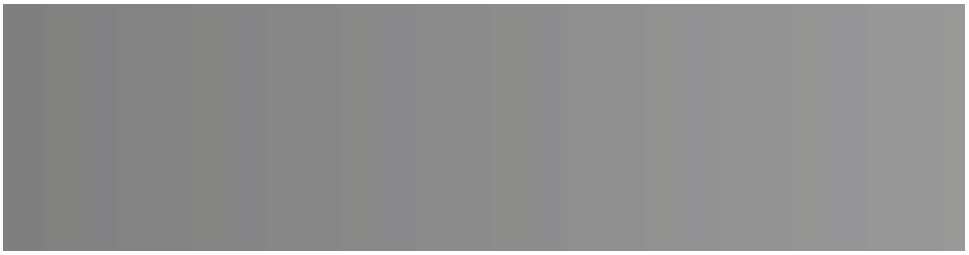
```
(*Compare 11 float to 10 float*)
Plot[{fromReal32Digits[binaryRound[real32Digits[x], 18]],
  fromReal32Digits[binaryRound[real32Digits[x], 17]]}, {x, 0.0, 1.0},
 PlotLegends → {"10 bit float quantization", "11 bit float quantization"}]
```



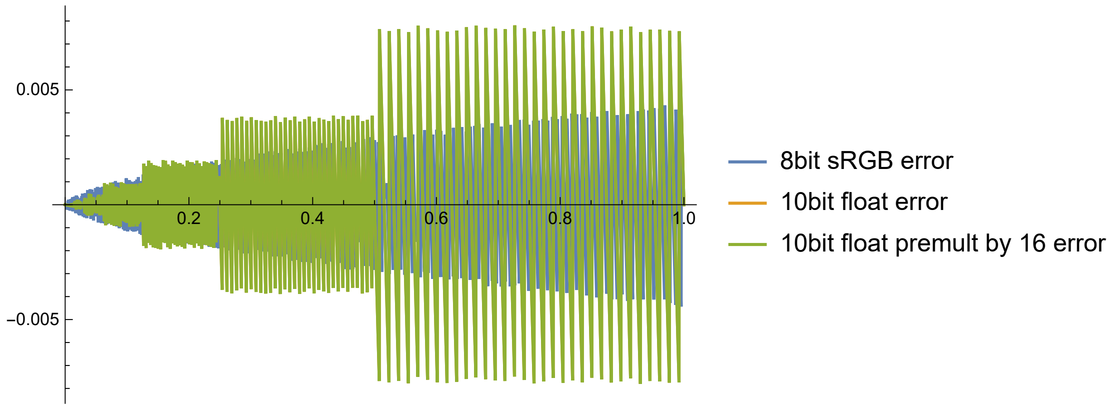
```
(*Compare 11 float to 10 float, range 0.8-1.0*)
Plot[{fromReal32Digits[binaryRound[real32Digits[x], 18]],
  fromReal32Digits[binaryRound[real32Digits[x], 17]]}, {x, 0.8, 1.0},
 PlotLegends → {"10 bit float quantization", "11 bit float quantization"}]
```



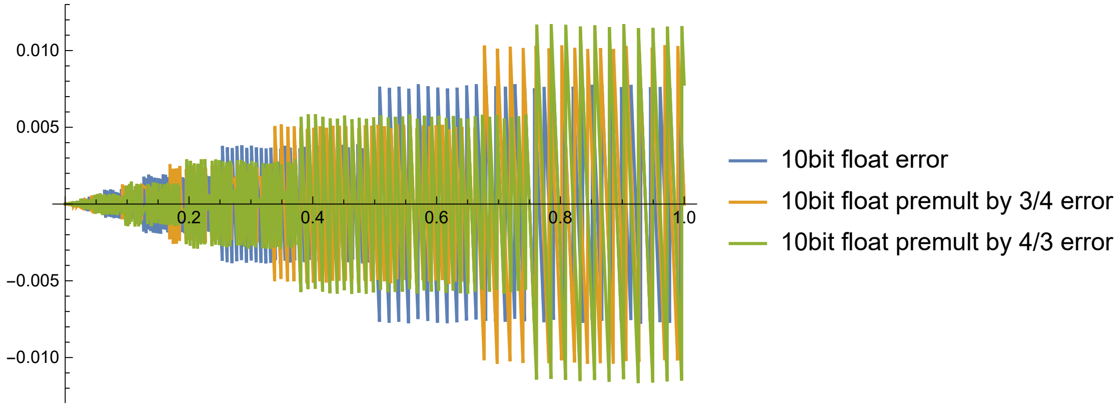
```
(*Show image with R11G11B10F gradient*)
Image[Transpose[Table[Module[{q11 = fromReal32Digits[binaryRound[real32Digits[x], 17]],
     q10 = fromReal32Digits[binaryRound[real32Digits[x], 18]]},
    Table[{q11, q11, q10}, {col, 1, 128}]], {x, 0.5, 0.6, 0.0002}]], ColorSpace → "RGB"]
```



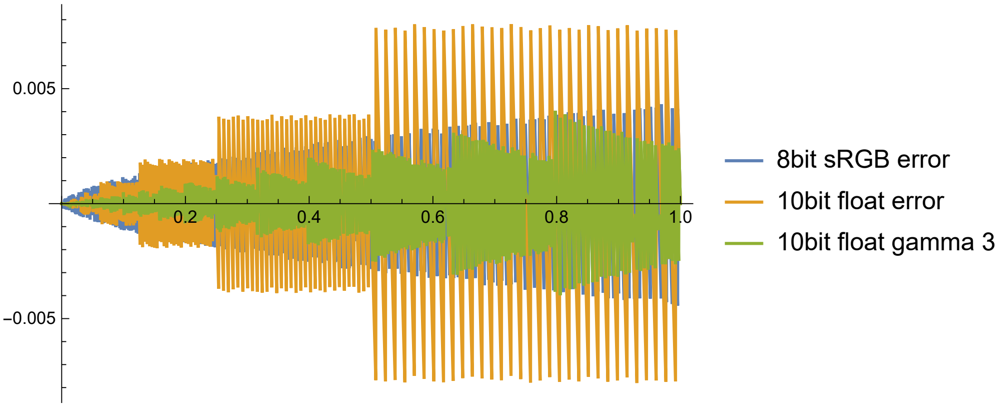
```
(*Show that premultiplying is not going to help with quantization error*)
Plot[{eightBitSrgb[x] - x, fromReal32Digits[binaryRound[real32Digits[x], 18]] - x,
  fromReal32Digits[binaryRound[real32Digits[x * 16], 18]] / 16 - x}, {x, 0, 1}, PlotLegends →
  {"8bit sRGB error", "10bit float error", "10bit float premult by 16 error"}]
```



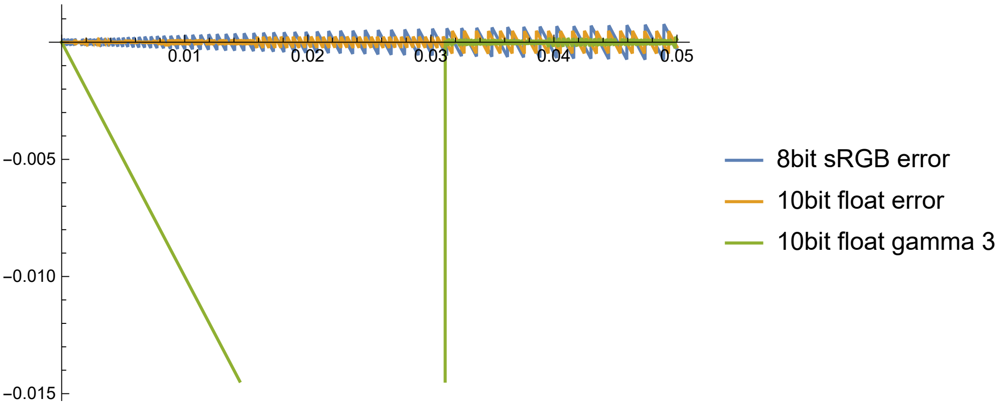
```
Plot[{fromReal32Digits[binaryRound[real32Digits[x], 18]] - x,
  fromReal32Digits[binaryRound[real32Digits[x * 3 / 4], 18]] * 4 / 3 - x,
  fromReal32Digits[binaryRound[real32Digits[x * 4 / 3], 18]] * 3 / 4 - x},
 {x, 0, 1}, PlotLegends → { "10bit float error",
   "10bit float premult by 3/4 error", "10bit float premult by 4/3 error"}]
```



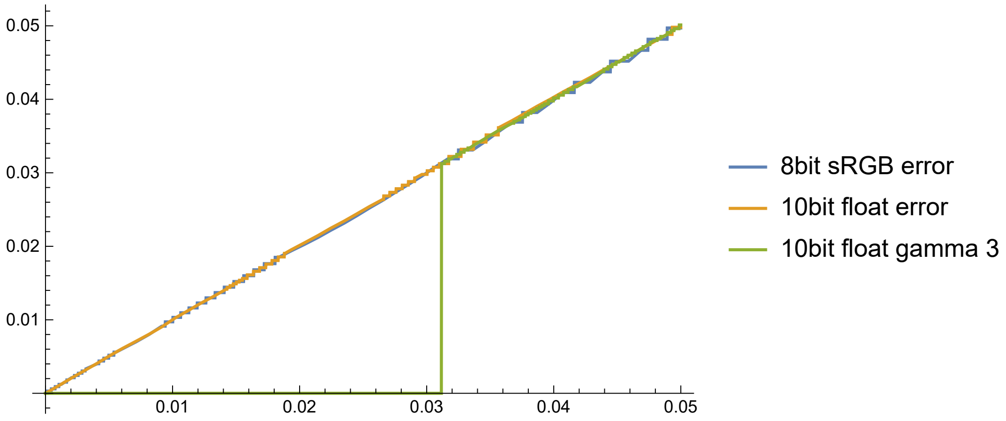
```
(*Apply a gamma function*)
Plot[{eightBitSrgb[x] - x, fromReal32Digits[binaryRound[real32Digits[x], 18]] - x,
  Power[fromReal32Digits[binaryRound[real32Digits[x * x * x], 18]], 1/3] - x}, {x, 0, 1},
 PlotLegends → {"8bit sRGB error", "10bit float error", "10bit float gamma 3"}]
```



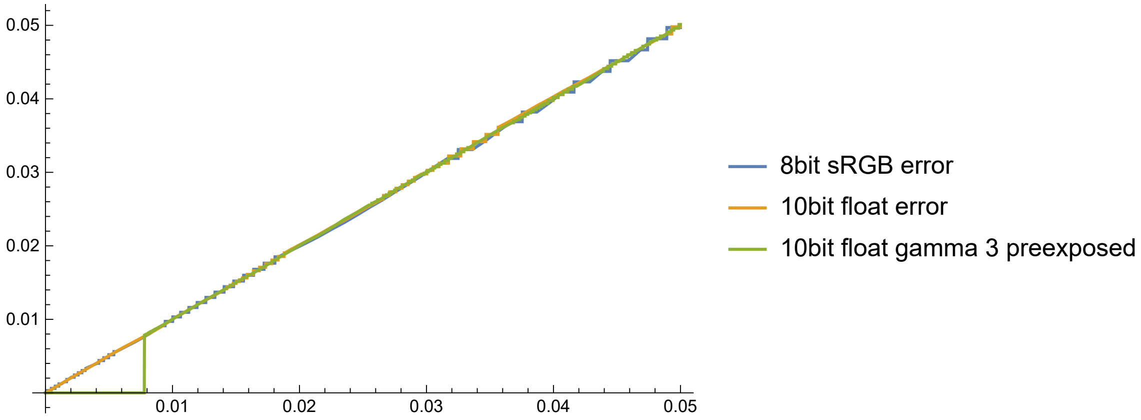
```
(*Actual zoomed in error *)
Plot[{eightBitSrgb[x] - x, fromReal32Digits[binaryRound[real32Digits[x], 18]] - x,
  Power[Module[{y = fromReal32Digits[binaryRound[real32Digits[x * x * x], 18]]},
     If[y < 1/32768, 0, y]], 1/3] - x}, {x, 0, 0.05},
 PlotLegends → {"8bit sRGB error", "10bit float error", "10bit float gamma 3"}]
```



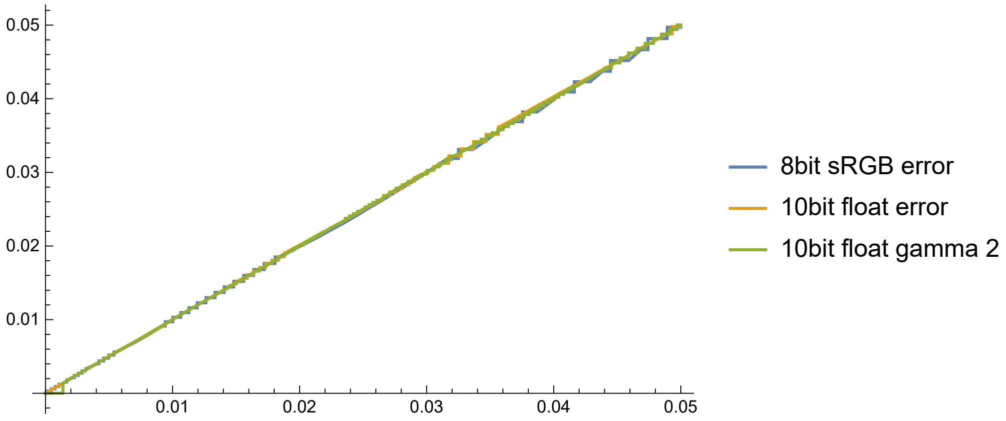
```
(*How the signal actually clips*)
Plot[{eightBitSrgb[x], fromReal32Digits[binaryRound[real32Digits[x], 18]],
  Power[Module[{y = fromReal32Digits[binaryRound[real32Digits[x * x * x], 18]]},
     If[y < 1/32768, 0, y]], 1/3]}, {x, 0, 0.05},
 PlotLegends → {"8bit sRGB error", "10bit float error", "10bit float gamma 3"}]
```



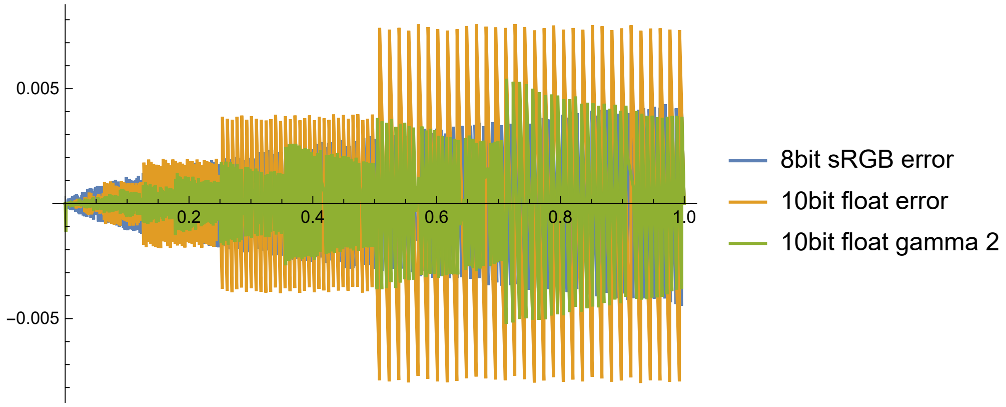
```
(*Improving it a bit with preexposing by 4*)
Plot[{eightBitSrgb[x], fromReal32Digits[binaryRound[real32Digits[x], 18]],
  Power[Module[{y = fromReal32Digits[binaryRound[real32Digits[Power[4 * x, 3]], 18]]},
      If[y < 1/32768, 0, y]], 1/3] / 4}, {x, 0, 0.05},
 PlotLegends → {"8bit sRGB error", "10bit float error", "10bit float gamma 3 preexposed"}]
```



```
(*Alternative: just use gamma 2!*)
Plot[{eightBitSrgb[x], fromReal32Digits[binaryRound[real32Digits[x], 18]],
  Power[Module[{y = fromReal32Digits[binaryRound[real32Digits[Power[4 * x, 2]], 18]]},
     If[y < 1/32768, 0, y]], 1 / 2] / 4}, {x, 0, 0.05},
 PlotLegends → {"8bit sRGB error", "10bit float error", "10bit float gamma 2"}]
```



```
(*Error with gamma 2, not great, but not too bad*)
Plot[{eightBitSrgb[x] - x, fromReal32Digits[binaryRound[real32Digits[x], 18]] - x,
  Power[Module[{y = fromReal32Digits[binaryRound[real32Digits[Power[4 * x, 2]], 18]]},
      If[y < 1/32768, 0, y]], 1 / 2] / 4 - x}, {x, 0, 1.0},
 PlotLegends → {"8bit sRGB error", "10bit float error", "10bit float gamma 2"}]
```


8bit sRGB error
10bit float error
10bit float gamma 2