

Fast **VDO**

like it's meant to be...

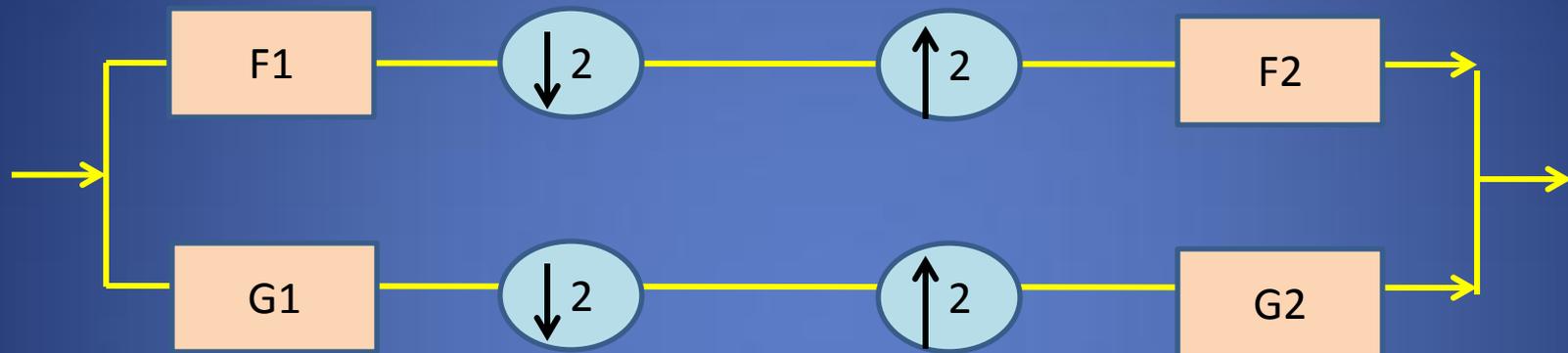
JCTVC-J0127

**Integer Color Transforms and Resampling Filters
for HEVC Extensions:
Scalability, 3DV, and Higher Chroma Coding**

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2-Ch Perf Recon Filter Bank (PRFB)



- 2 Ch Perfect Recon Filter Banks
 - 1980s - Smart co-design of filters allow alias cancelation
 - 1990s – discover lifting based approaches
 - 2000 – JPEG2000

Sampling = 1-Ch FB. PR?



- Sampling (down and up) is a 1-Ch FB
 - Perf Recon is no longer possible
 - But we can still cancel some aliasing!
 - Related to Laplace Pyramid; have lifting interpretation
- Moral: can do better than half-band filters

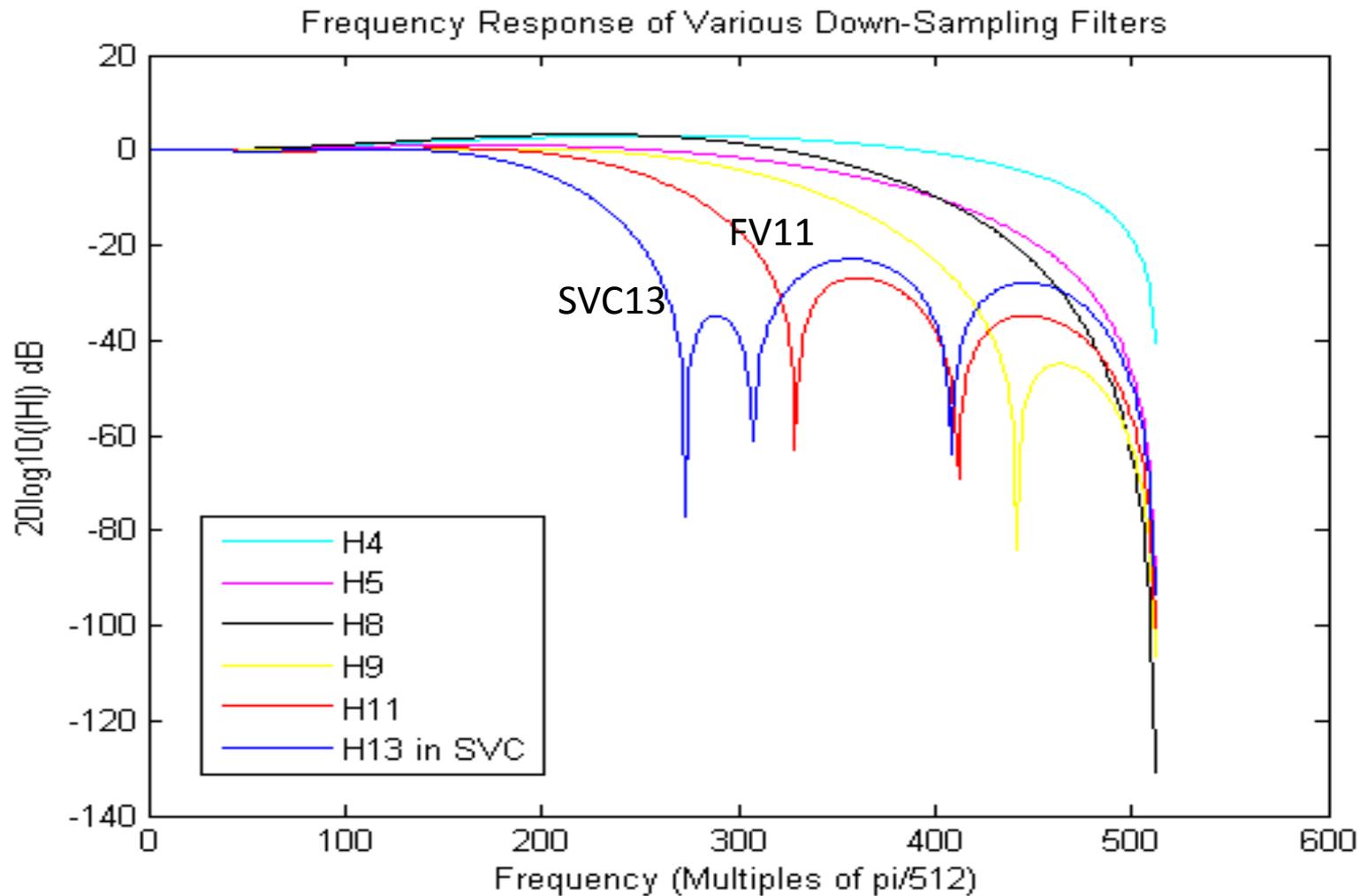
Standard Half-Band Filters (SVC)

- Down
 - $\text{svc13} = [2 \ 0 \ -4 \ -3 \ 5 \ 19 \ 26 \ 19 \ 5 \ -3 \ -4 \ 0 \ 2] / 64$
- Up
 - $\text{Svc4} = [-3 \ 19 \ 19 \ -3] / 32$

FastVDO Anti-Alias Filters

- Down
 - $fv11 = [1 \ 0 \ -3 \ 0 \ 10 \ 16 \ 10 \ 0 \ -3 \ 0 \ 1] / 32$
- Up
 - $fv4 = [-1 \ 5 \ 5 \ -1] / 8$

Spectral Response (Downsamplers)

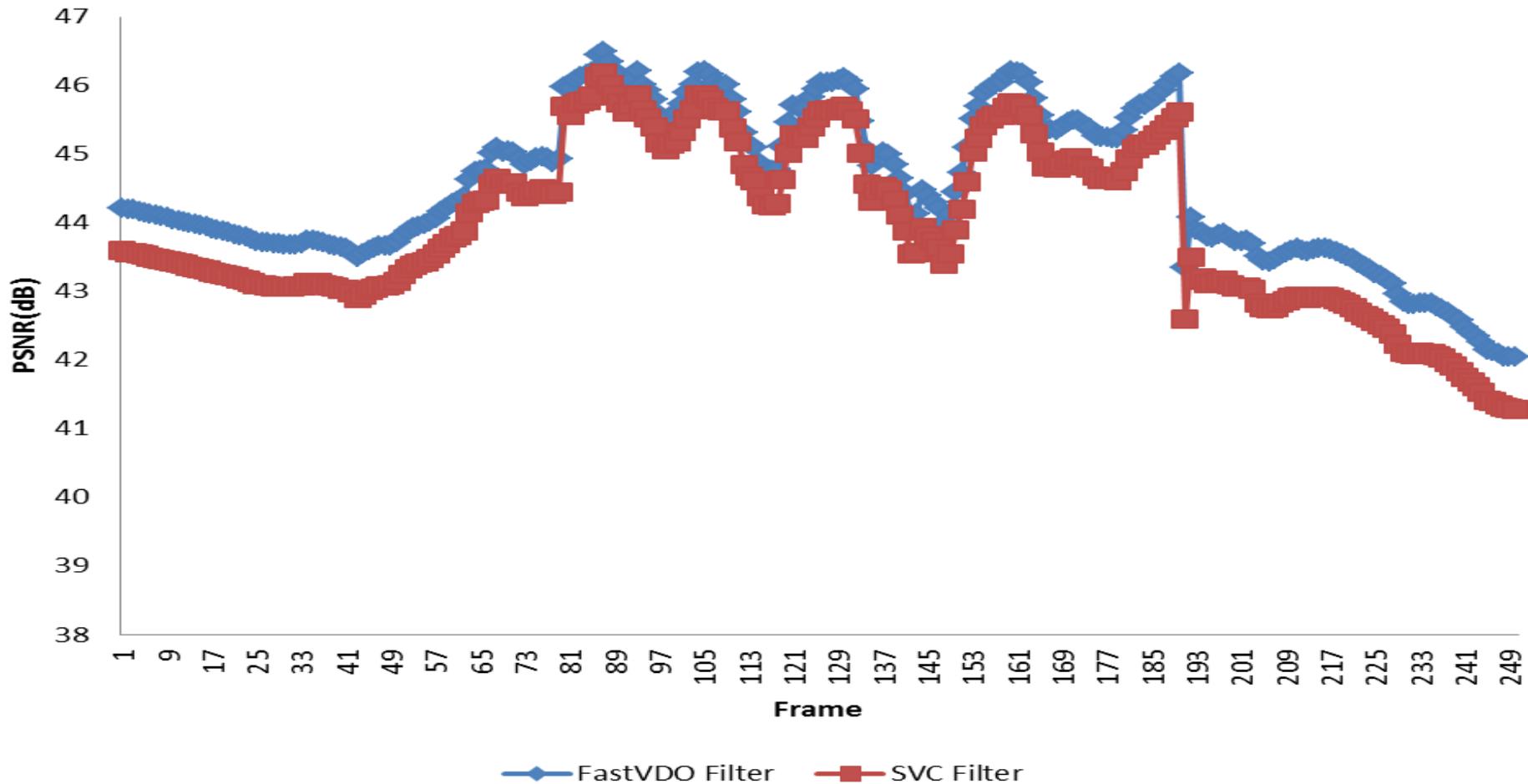


Tests: Outperforms SVC Filters

- Consistent 0.7 – 1.2 dB gain in all test seqs
 - Outperforms SVC on every frame!
- Wide application in many domains
 - Spatial scalability
 - Adaptive Resolution Coding (ARC)
 - Adaptive Chroma Coding (ACC)
 - 3DV (depth map coding)



Application Example: Depth Map*



*Dancer sequence



Chroma Quality

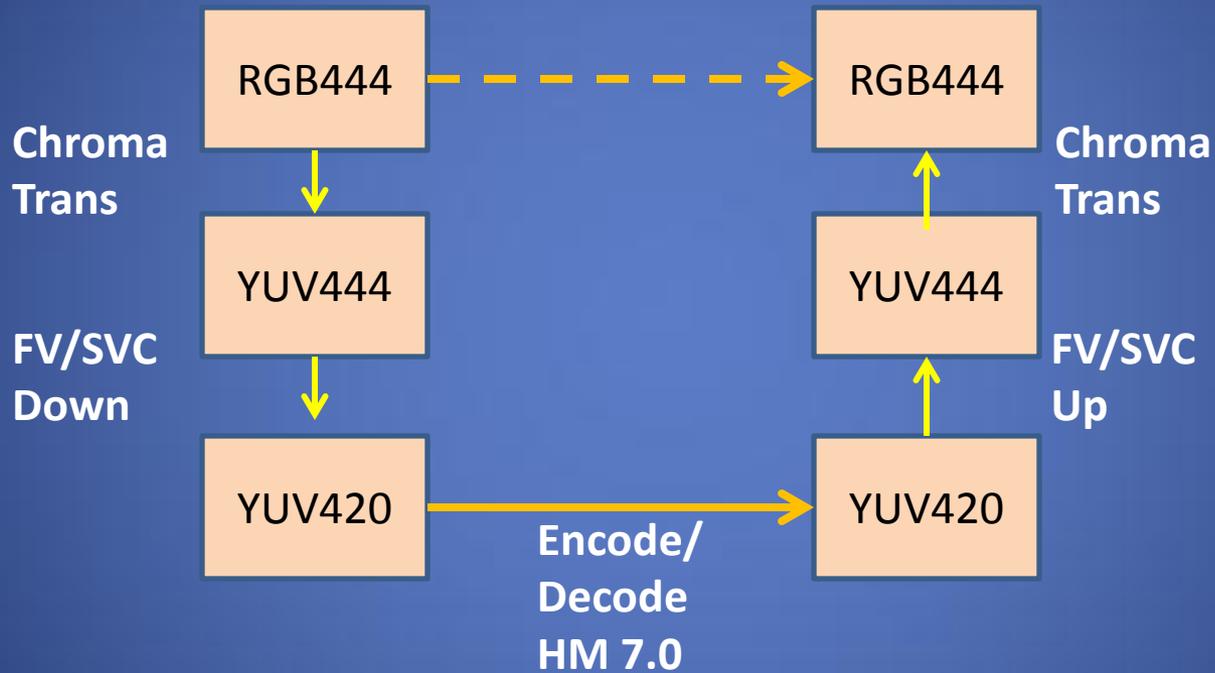
- Sensors and displays mostly work in RGB
 - But codecs mostly work in YUV
 - We constantly pay a price in chroma quality
 - Big gains if we sample carefully!
 - Need not resort to full 4:4:4 coding to get gains

Test Chroma Transforms

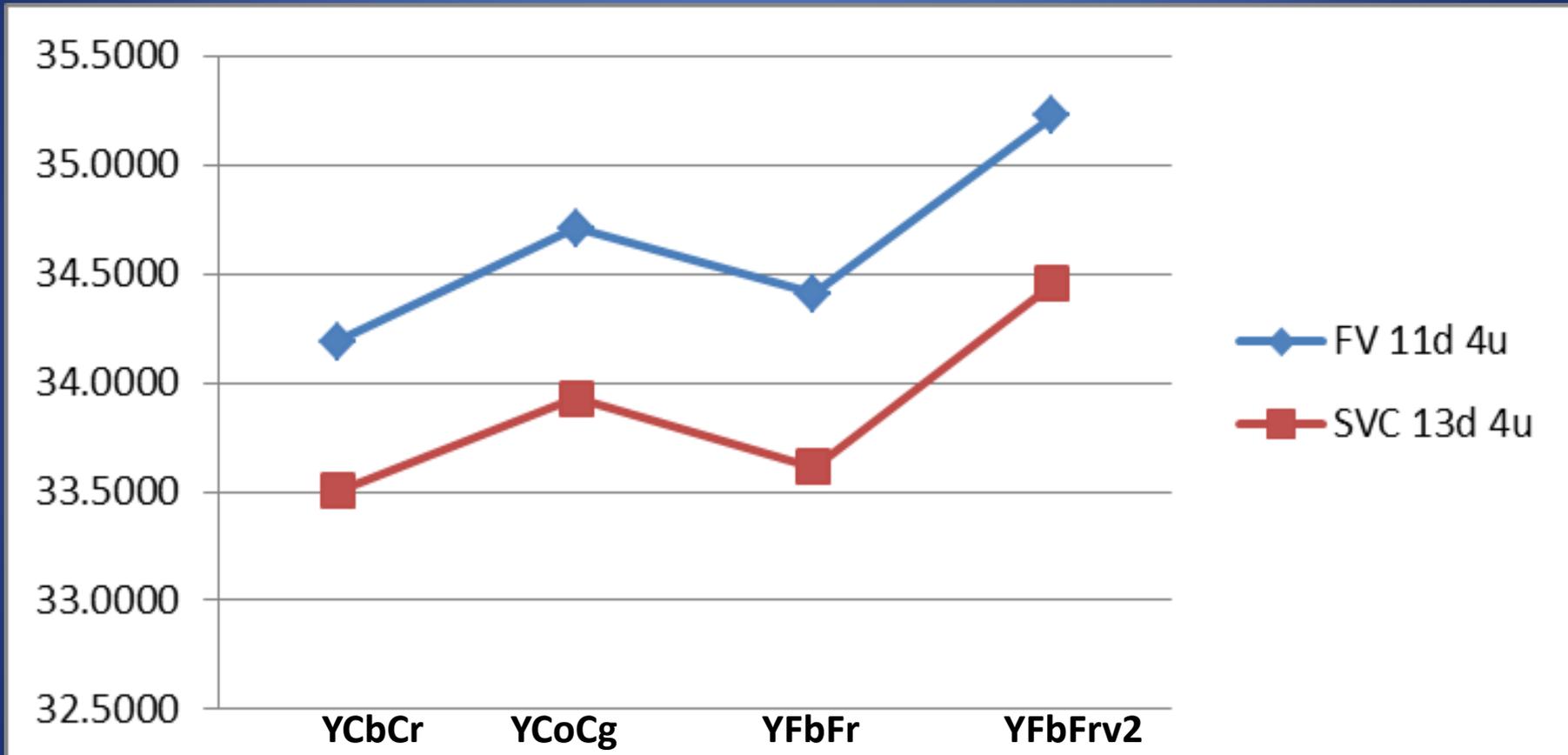
- $YCbCr = [.299 \ .587 \ .114; \ .5 \ -.419 \ -.081; \ -.169 \ -.331 \ .5];$
- $YUV = [.299 \ .587 \ .114; \ -.147 \ -.289 \ .436; \ .615 \ -.515 \ .1];$
- $DCT = [.577 \ .577 \ .577; \ .707 \ 0 \ -.707; \ .408 \ -.816 \ .408];$
- $YCoCg = [.25 \ .5 \ .25; \ 1/2 \ 0 \ -1/2; \ -.25 \ .5 \ -.25];$
- $YFbFr = [5/16 \ 3/8 \ 5/16; \ -1/2 \ 1 \ -1/2; \ 1 \ 0 \ -1];$
- $YFbFrv2 = [3/16 \ 5/8 \ 3/16; \ -1/2 \ 1 \ -1/2; \ 1 \ 0 \ -1];$

- Any of these can be called YUV4444
- The last 3 (and YCbCr) have a precise integer definition

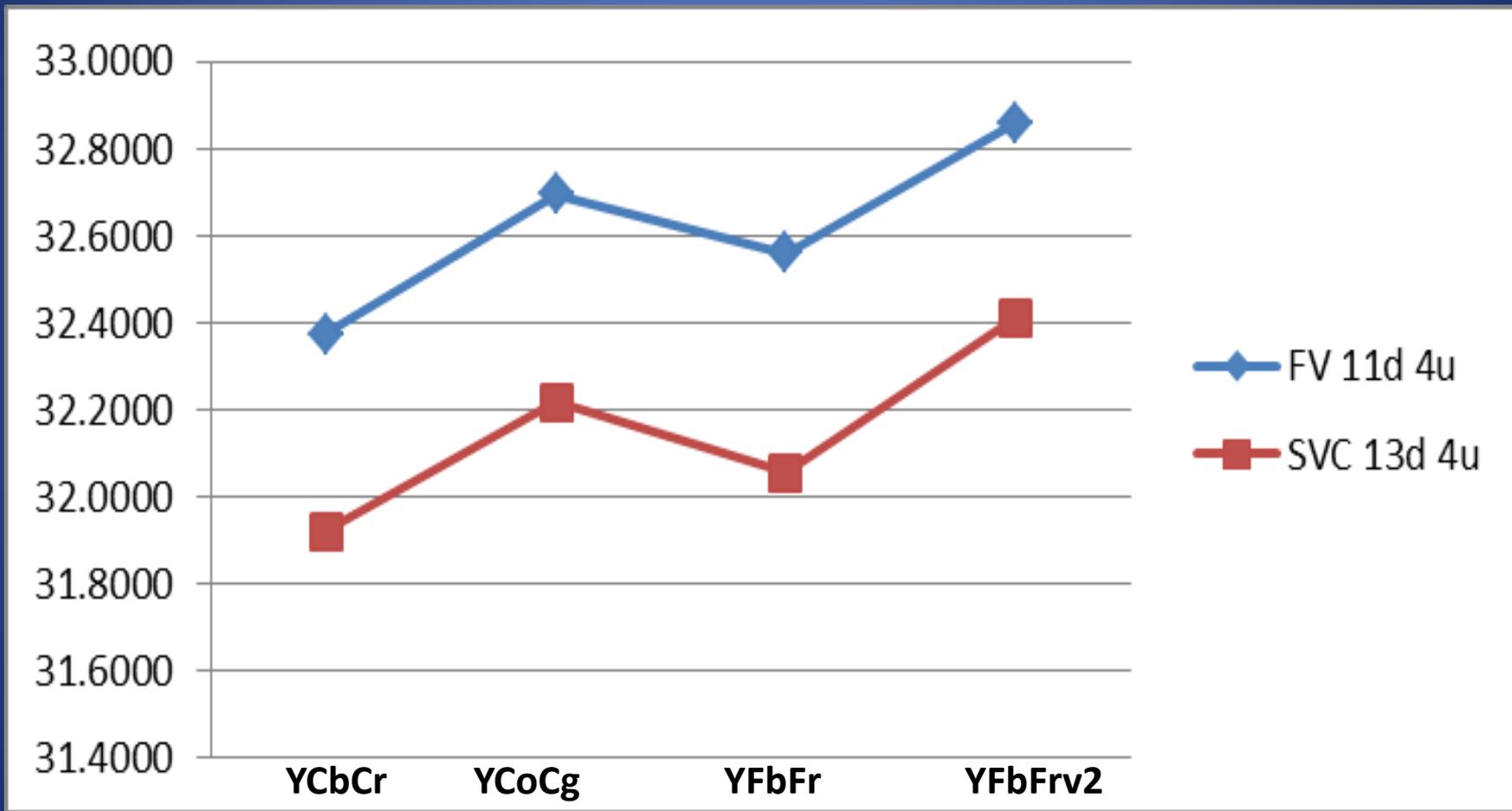
Test Methodology



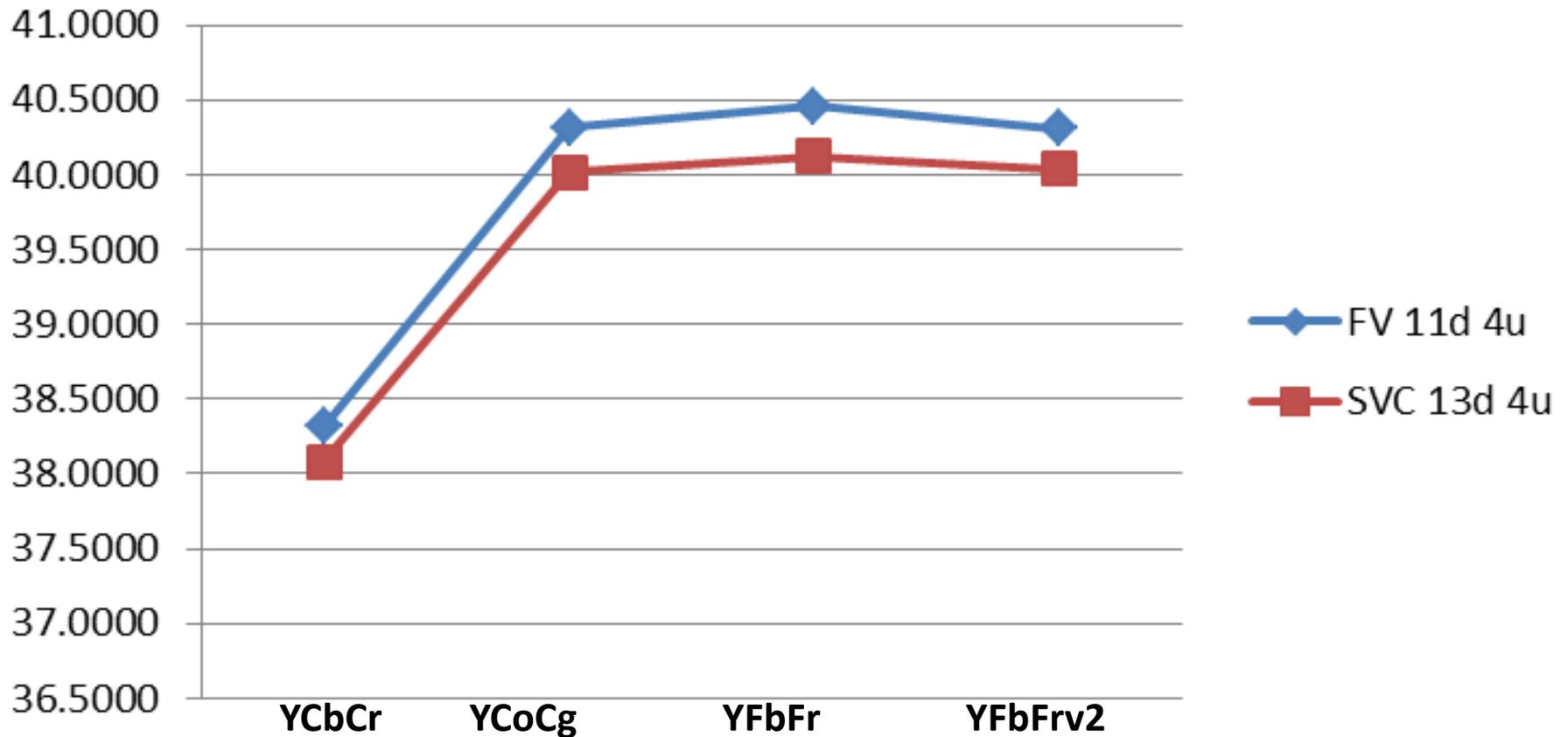
Example Result (No Comp): Crowdrun



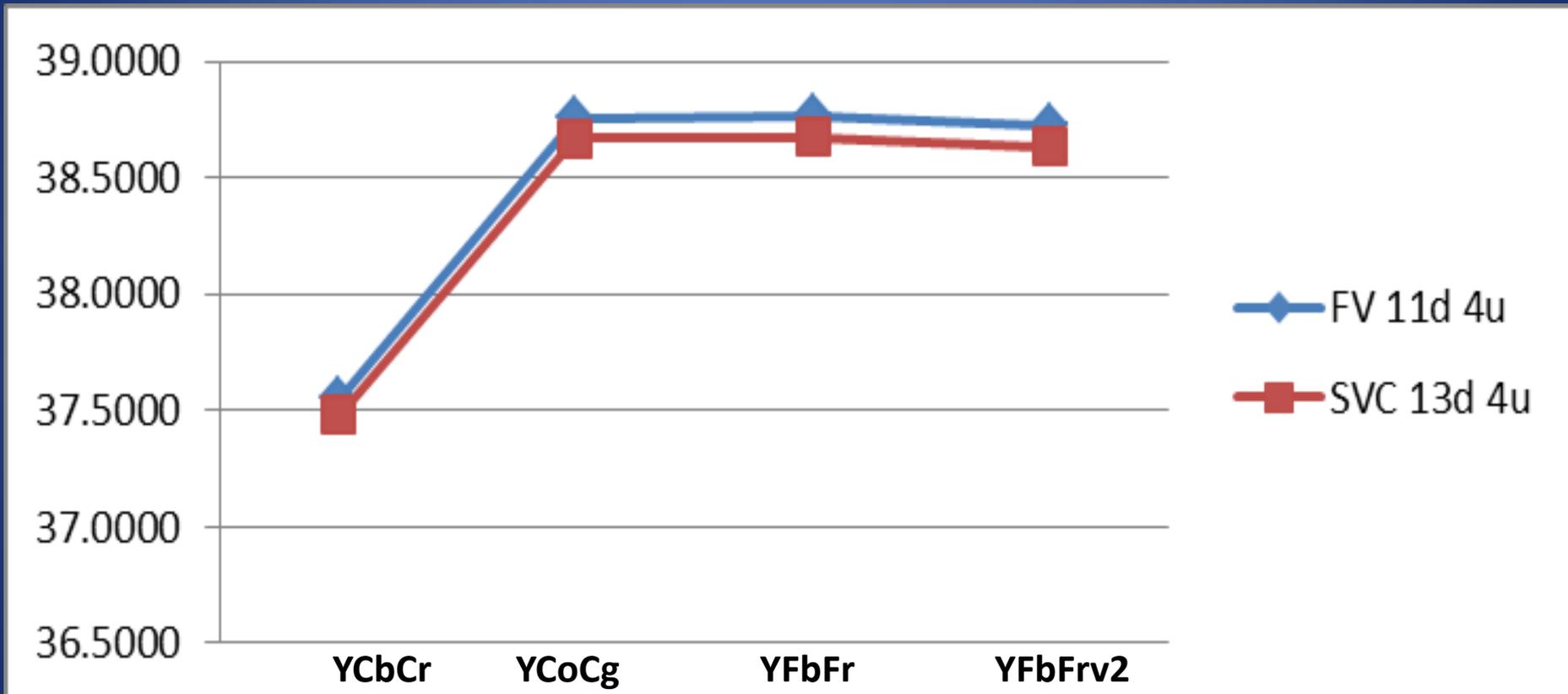
Crowdrun, w/ $Q_p = 22$



Example: KungFu Seq. Over 40dB!



KungFu w/ $Q_p = 22$



Possible Usage Models

- Method 1. Low Complexity
 - RGB444 as I/O
 - Use our YUV420 intermediates for coding
- Method 2. Adaptive Chroma Coding (ACC)
 - Use separate color plane coding
 - Adaptively convert to optimize performance



Conclusion

- Powerful spatial and chroma sampling filters
- Powerful chroma transforms
- Combination can provide useful gains for free
 - Careful sampling / colour management
- Benchmarks for 444 and 422 tool testing

Suggestion

- Adopt as testing tools for Prof Extensions
- Prof extension tools must outperform these
 - And justify their complexity vs these tools