

Study of MC interpolation filter for bi-prediction JVCTV-B083

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Summary

- SFIF and SAIF were proposed as a response of CfP in JCTVC-A103
 - SFIF (Separable Fixed Interpolation Filter)
 - High precision separable filter
 - SAIF (Separable Adaptive Interpolation Filter)
 - AIF filter sets for single pred and bi-pred
 - Reduction of AIF filter overhead to improve B-Pic.
- This contribution provide more detail information and performance analysis of MC interpolation filter switching for bi/single pred

Separate Filters for Bi vs. Single

- Motivation

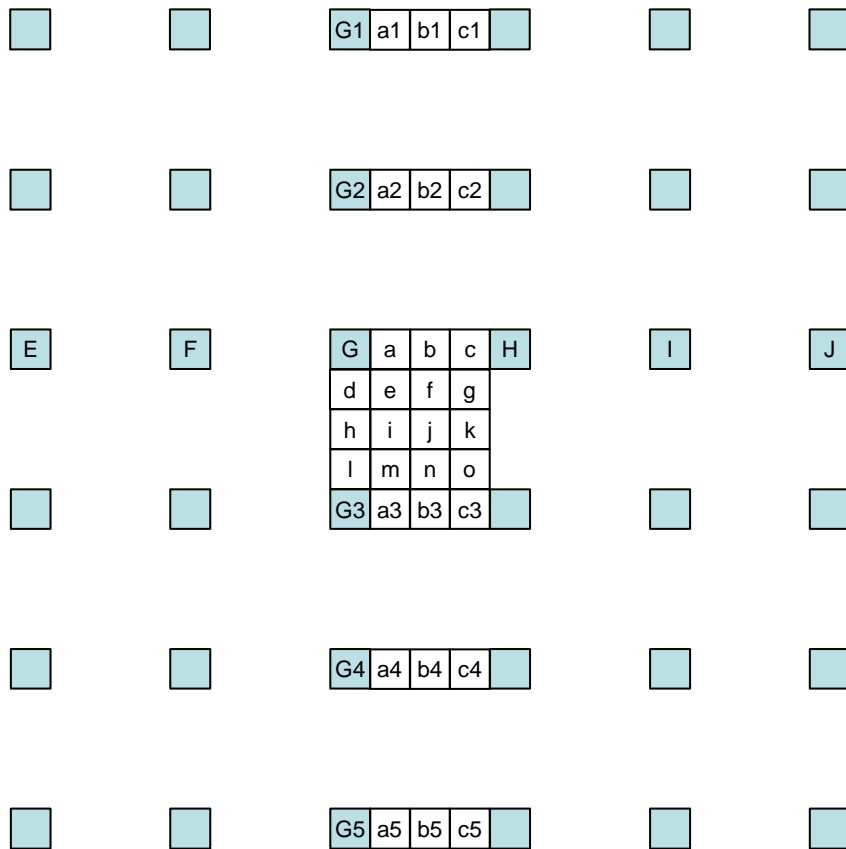
- Compensation for loss of high frequency in bi-prediction due to averaging of L0 and L1 references

- Proposal

- Switching filters based on bi-prediction or single prediction mode
 - In FIF scheme, 3 sets of filters are pre-designed (switch 3 filters by bi-pred or single)
 - In AIF scheme, it estimates 2 sets of filters for bi-pred and single pred
- This method can be applied to various interpolation methods, e.g. SIFO, 1/8 pel, 1/12 pel, 8 tap, or 12 tap

Separable Fixed Interpolation Filter (SFIF)

To improve computational accuracy, both quarter pel and half pel value are derived directly by separable interpolation filter with higher precision



Step 1:

Horizontal interpolation is applied to derive pixels a, b and c

Step 2:

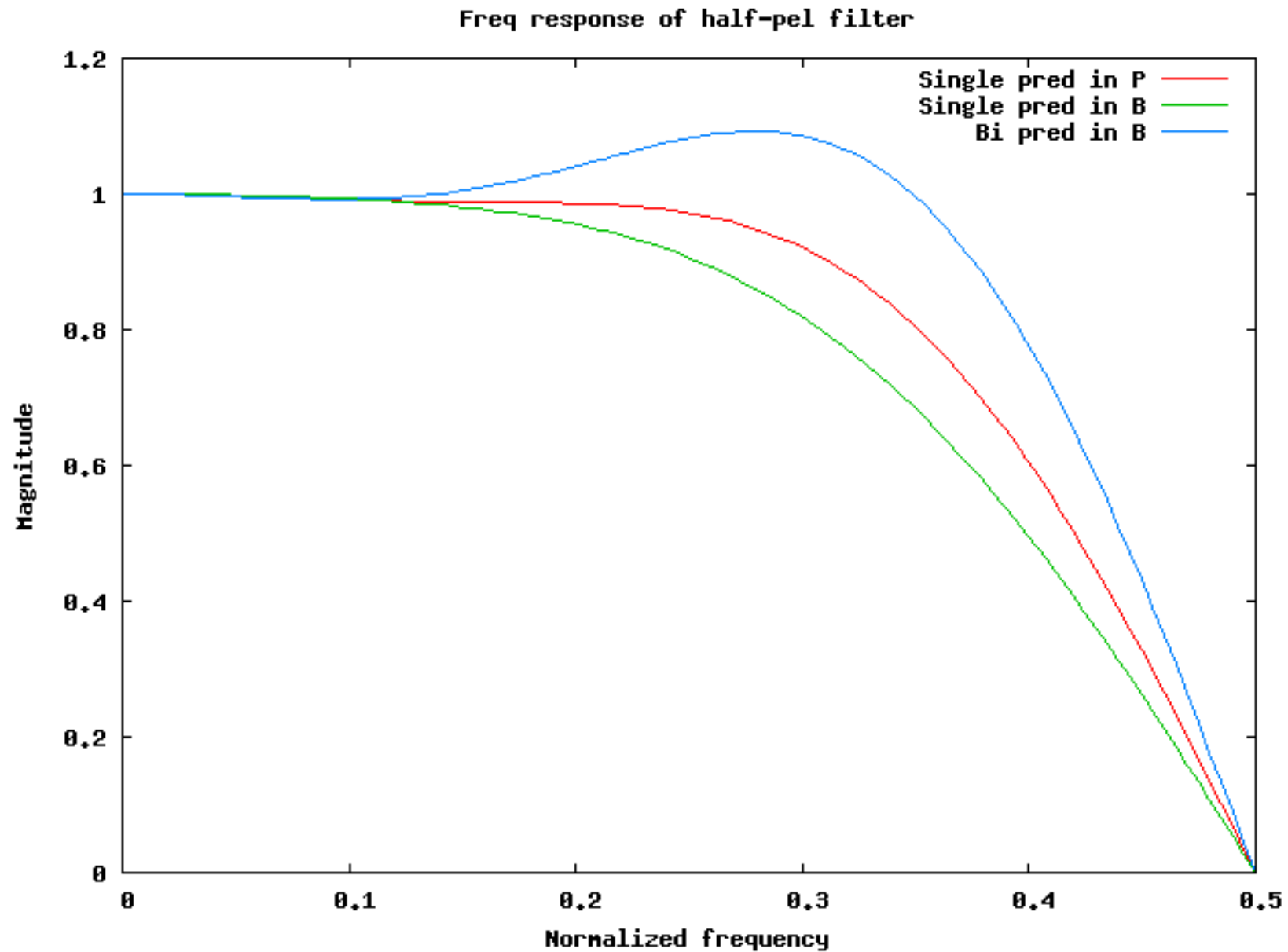
Vertical interpolation is applied to derive pixels d-o

3 filter sets are defined.

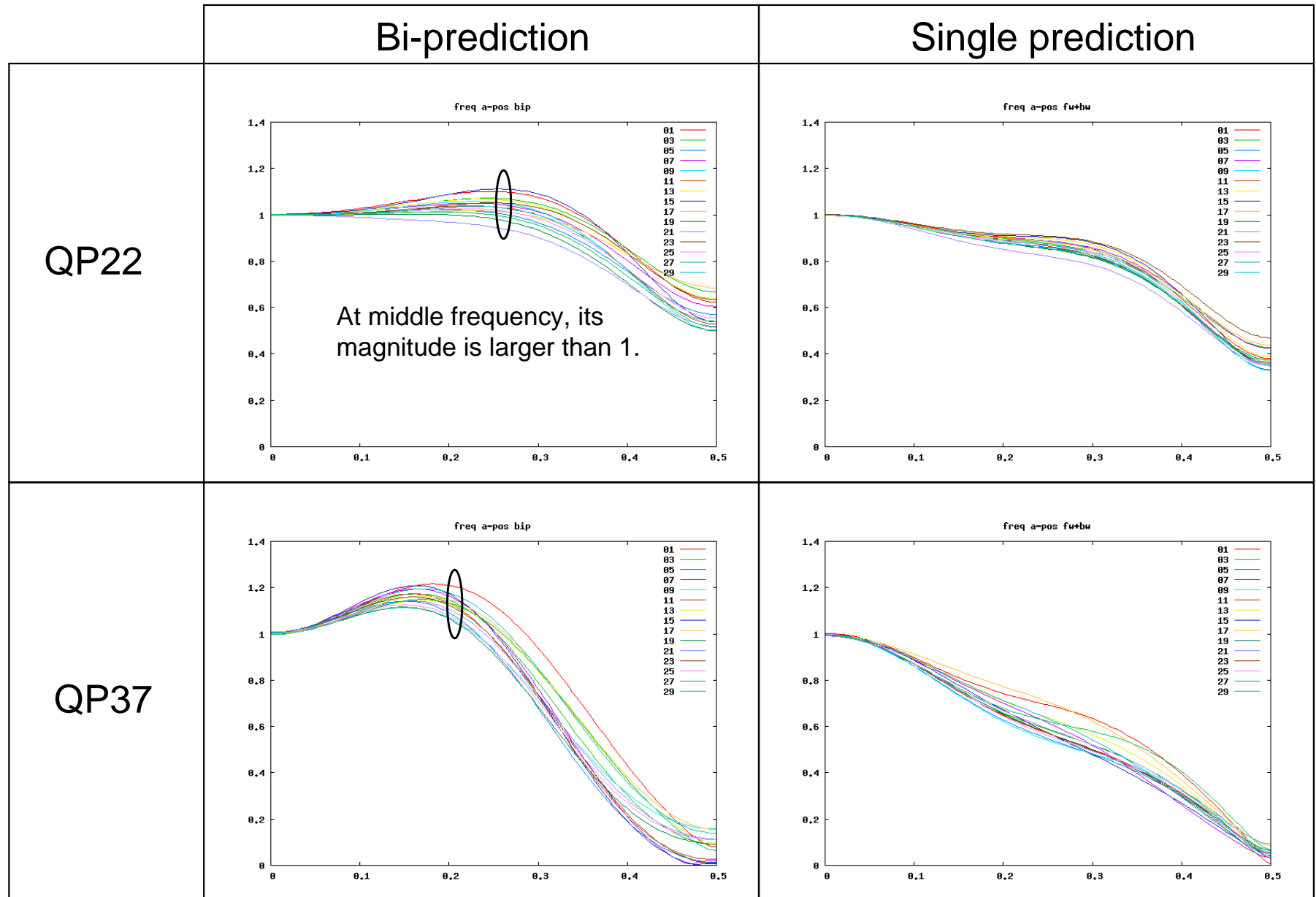
- Single pred in P picture
- Single pred in B picture
- Bi-pred in B picture

Filters can be switched using SIFO scheme

Frequency response for SFIF



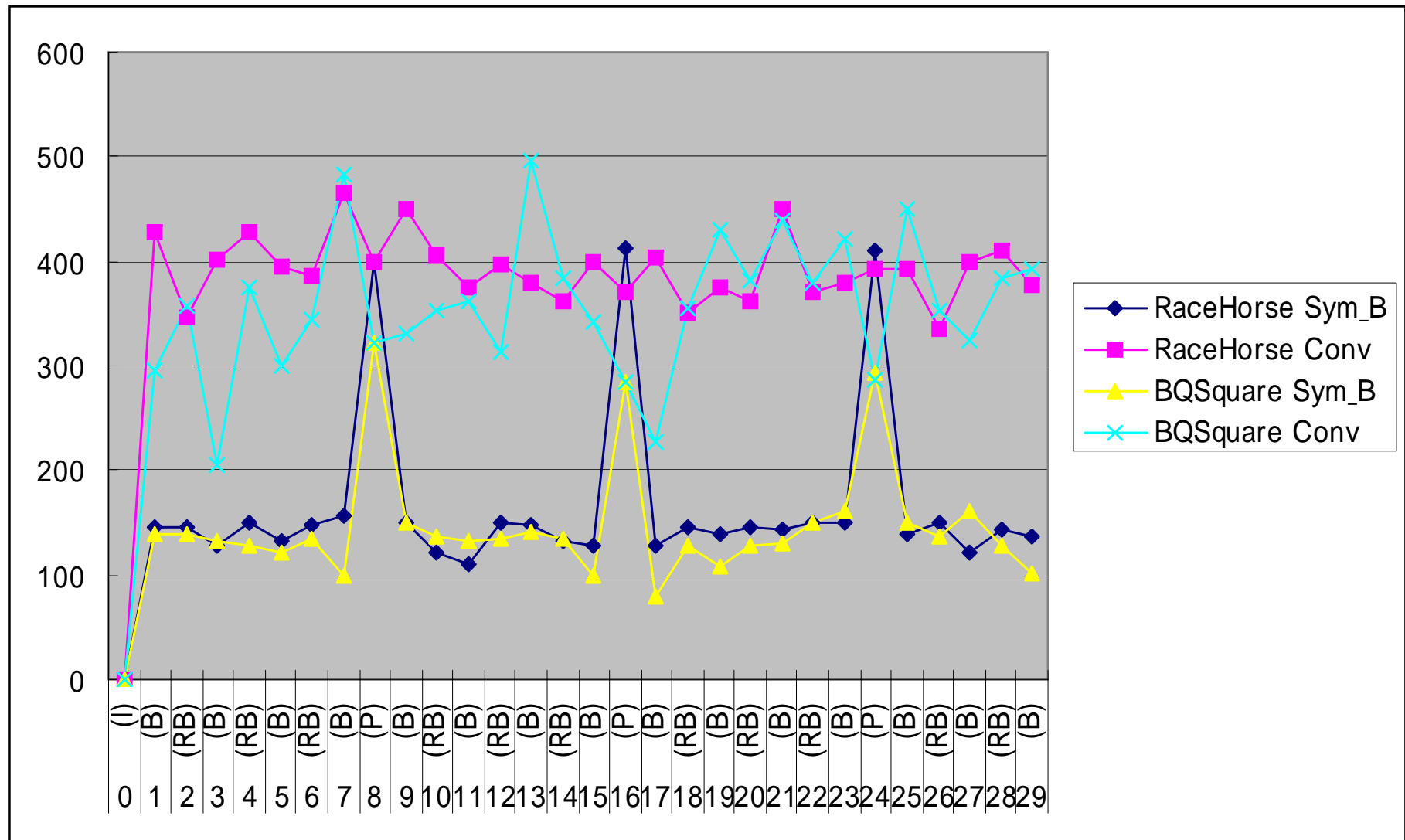
Frequency response for SAIF



Reduction of Filter Coefficients

Sub pel position	P slice	B slice
a	6	6
b	3	3
c	6	same as reflection of a
d	6	6
e	6	same as reflection of d
f	6	same as reflection of d
g	6	same as reflection of d
h	3	3
i	3	same as h
j	3	same as h
k	3	same as h
l	same as reflection of d	same as reflection of d
m	same as reflection of e	same as reflection of d
n	same as reflection of f	same as reflection of d
o	same as reflection of g	same as reflection of d
Total of number of coefficients	51	18 (36 if two sets of filters are used)

Bit reduction of header



Test Conditions

- Follows transform AHG and TE2
- Use JMKA 2.6r1 with the following setting
 - MVCompetition = 1 # Enabled with default parameters
 - UseIntraMDDT = 1 # Use MDDT for intra blocks
 - UseHPFilter = 1 # Use High Precision H.264 filter
 - UseAdaptiveLoopFilter = 1 # Use adaptive loop filtering
 - UseExtMB = 2 # Use extended block size (64x64)
 - InputBitDepth = 8 # InputBitDepth for IBDI
 - BitDepthLuma = 12 # Bit Depth for Luminance
 - BitDepthChroma = 12 # Bit Depth for Chrominance
- In addition to the above setting, the proposal is compared with the case with all new tools OFF (AVC)

SFIF

- The proposal is compared as follows
 - “SFIF_BiSingle”:
 - Separable SFIF (use Bi/Single)
 - “FDIF”:
 - FDIF in JMKTA 2.6r1 (UseHPFilter = 2)
 - “SIFO”:
 - SIFO in JMKTA 2.6r1 (UseHPFilter = 3)

CS	Range	Proposal	SIFO	FDIF
CS1 (ave)	R1-R4	-3.46	-1.51	-2.26
CS1 (max)	R1-R4	-20.54	-8.50	-12.11
CS1 (ave)	R2-R5	-4.41	-1.09	-1.66
CS1 (max)	R2-R5	-23.60	-9.57	-12.50
CS1	all	-3.93	-1.71	-2.54
CS2 (ave)	R1-R4	-2.71	-2.60	-4.61
CS2 (max)	R1-R4	-9.64	-8.94	-14.87
CS2 (ave)	R2-R5	-2.65	-2.45	-4.86
CS2 (max)	R2-R5	-8.22	-8.18	-13.55
CS2	all	-2.68	-2.52	-4.73

Figure 1: BD Rate for FIF with all new KTA tools off

CS	Range	Proposal	SIFO	FDIF
CS1 (ave)	R1-R4	-1.04	0.29	0.80
CS1 (max)	R1-R4	-10.54	-0.31	-0.58
CS1 (ave)	R2-R5	-1.41	0.05	0.80
CS1 (max)	R2-R5	-14.65	-0.14	-0.72
CS1	all	-1.22	0.17	0.80
CS2 (ave)	R1-R4	-0.32	-0.24	1.16
CS2 (max)	R1-R4	-3.88	-0.96	-1.29
CS2 (ave)	R2-R5	-0.48	-0.32	1.02
CS2 (max)	R2-R5	-4.96	-1.00	-1.56
CS2	all	-0.40	-0.28	1.09

Figure 1: BD Rate for FIF with TE2 test conditions

SAIF

- The proposal is compared as follows
 - “AIF_BiSingle”:
 - Separable FIF (No Bi/Single) + Separable AIF (used BiSingle)
 - “AIF_SAIF”:
 - HPF + Separable AIF (UseAdaptiveFilter = 2)
 - “AIF_EAIF”:
 - HPF + Enhanced AIF (UseAdaptiveFilter = 5)

	Filter structure	Tap length	DC offset	Bi/Single AIF	FIF If AIF=off	Coef reduction in B slice
Bi/Single filter	Separable (horizontal , vertical)	6 tap + 6tap	Not support	Yes	Separable FIF (but no Bi/single)	Yes
Separable AIF	Separable (horizontal , vertical)	6 tap + 6tap	Not support	No	HPF	No
E-AIF	2D radial, or diagonal cross	6 tap, or 12 tap non separable	support	No	HPF	No

CS	Range	Proposal	EaIF	SAIF
CS1 (ave)	R1-R4	-4.46	-4.04	-3.66
CS1 (max)	R1-R4	-16.25	-16.71	-14.76
CS1 (ave)	R2-R5	-5.43	-4.44	-4.27
CS1 (max)	R2-R5	-18.62	-16.08	-14.69
CS1	all	-4.95	-4.24	-3.96
CS2 (ave)	R1-R4	-7.32	-7.36	-6.85
CS2 (max)	R1-R4	-19.59	-20.97	-19.07
CS2 (ave)	R2-R5	-8.03	-7.32	-7.55
CS2 (max)	R2-R5	-17.56	-18.86	-17.24
CS2	all	-7.67	-7.34	-7.20

Figure 1: BD Rate for SAIF with all new KTA tools off

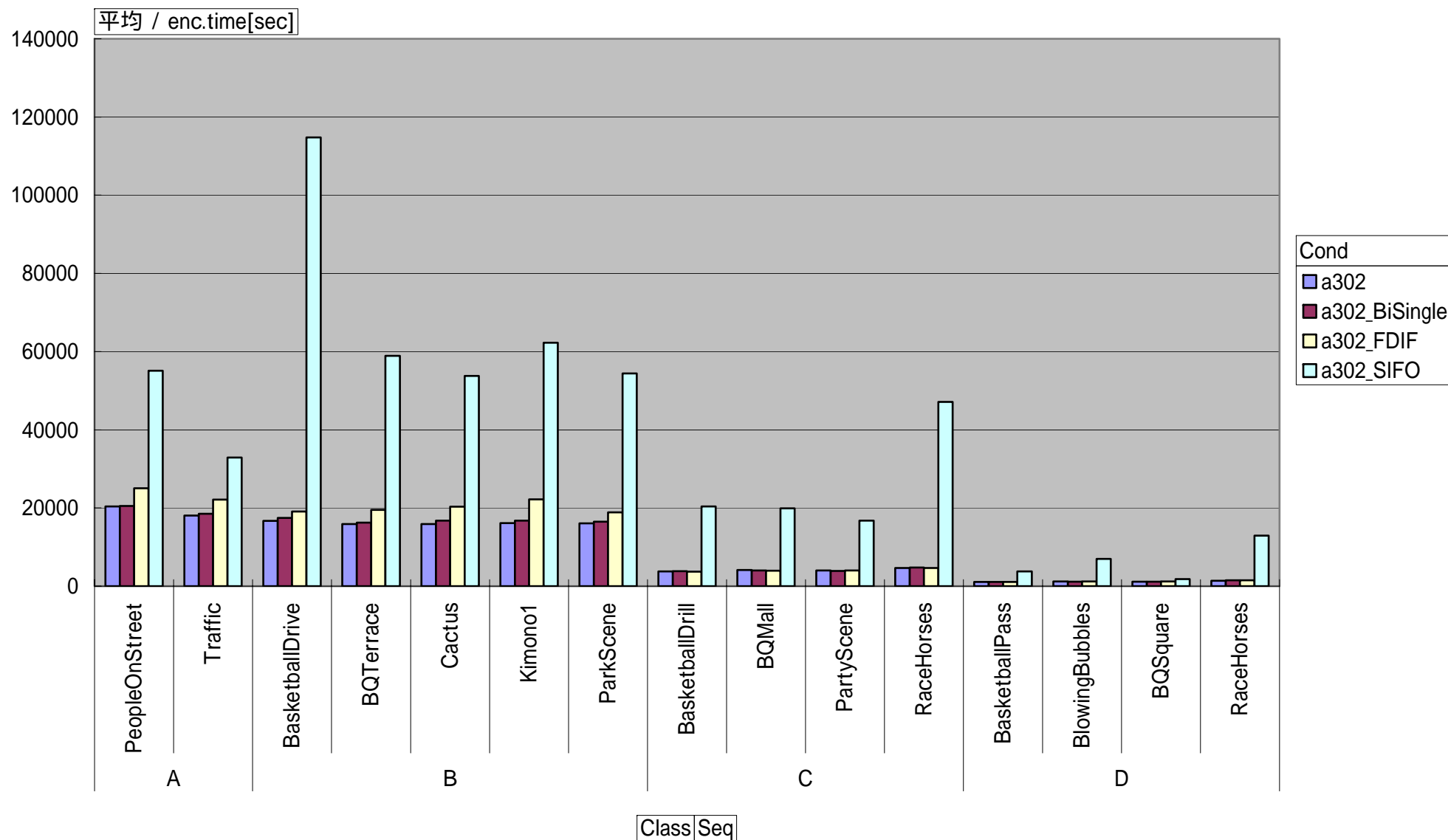
CS	Range	Proposal		
CS1 (ave)	R1-R4	-0.46		
CS1 (max)	R1-R4	-4.07		
CS1 (ave)	R2-R5	-0.78		
CS1 (max)	R2-R5	-6.63		
CS1	all	-0.62		
CS2 (ave)	R1-R4	-1.39		
CS2 (max)	R1-R4	-10.05		
CS2 (ave)	R2-R5	-1.74		
CS2 (max)	R2-R5	-11.68		
CS2	all	-1.56		

Figure 1: BD Rate for SAIF with TE2 test conditions

Simulation time

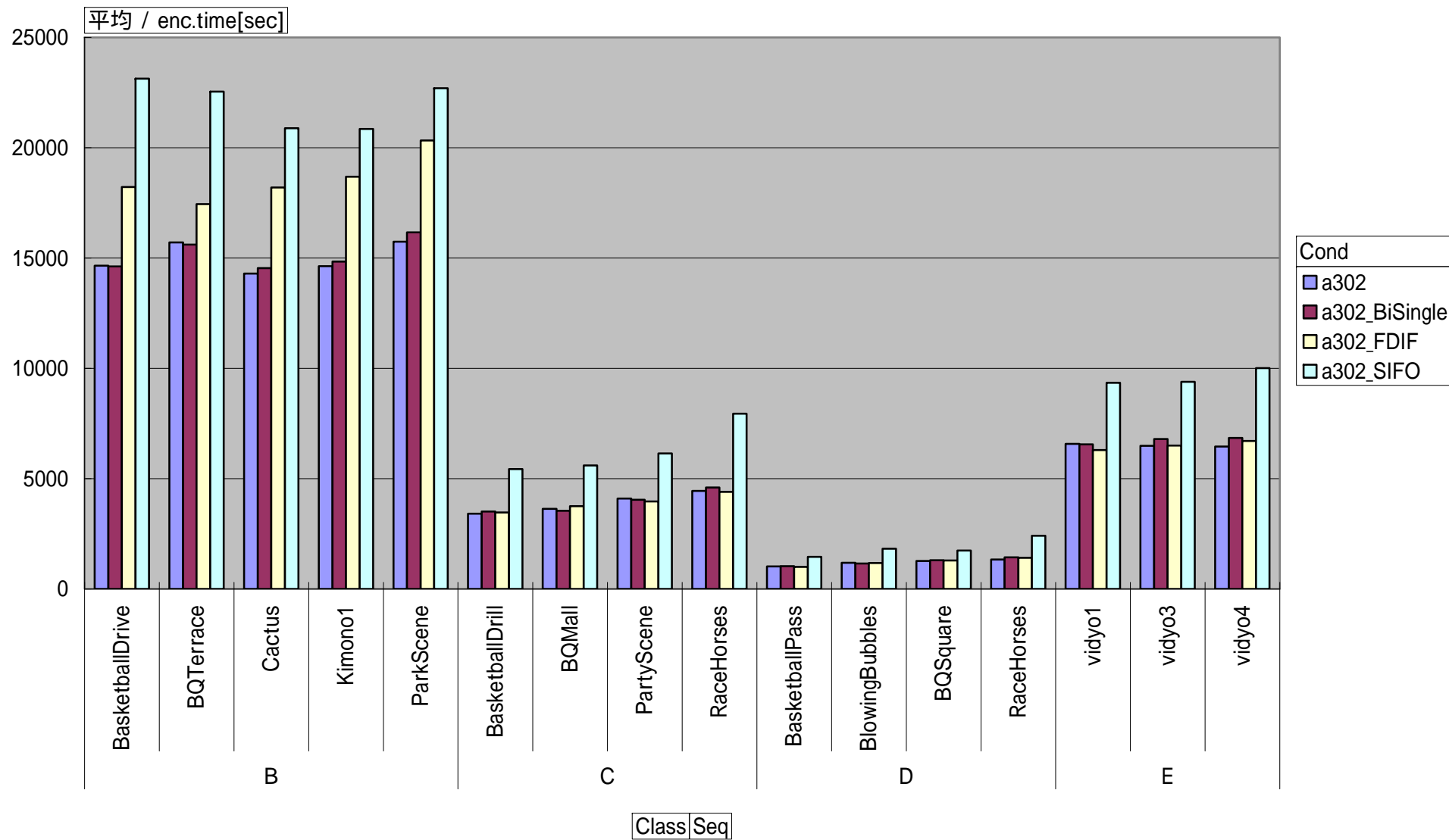
Encoder simulation time (SFIF, CS1)

Cs|c1|Rate|(すべて)



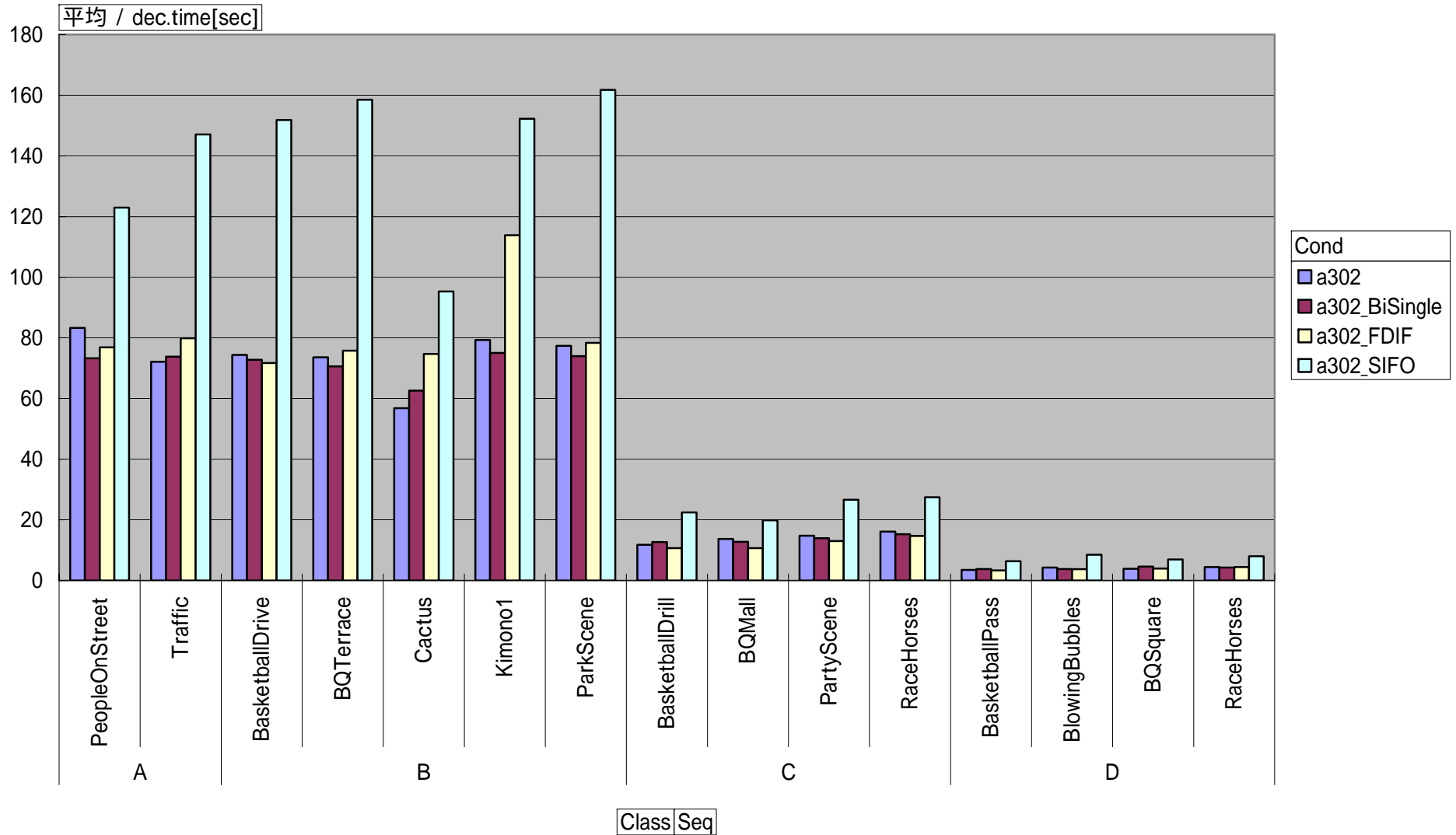
Encoder simulation time (SFIF, CS2)

Cs c2 Rate (すべて)



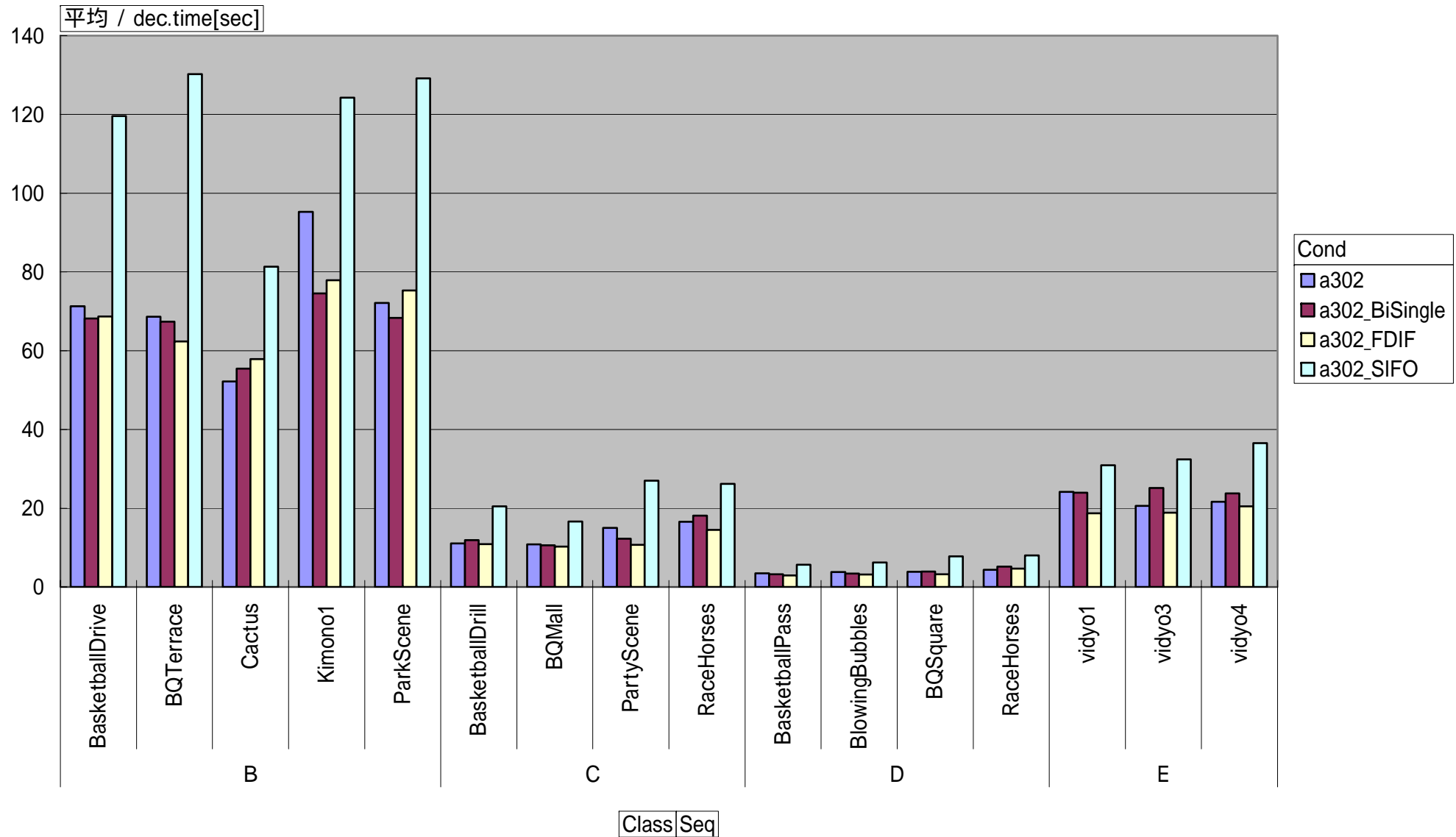
Decoder simulation time (SFIF, CS1)

Cs c1 Rate (すべて)



Decoder simulation time (SFIF, CS2)

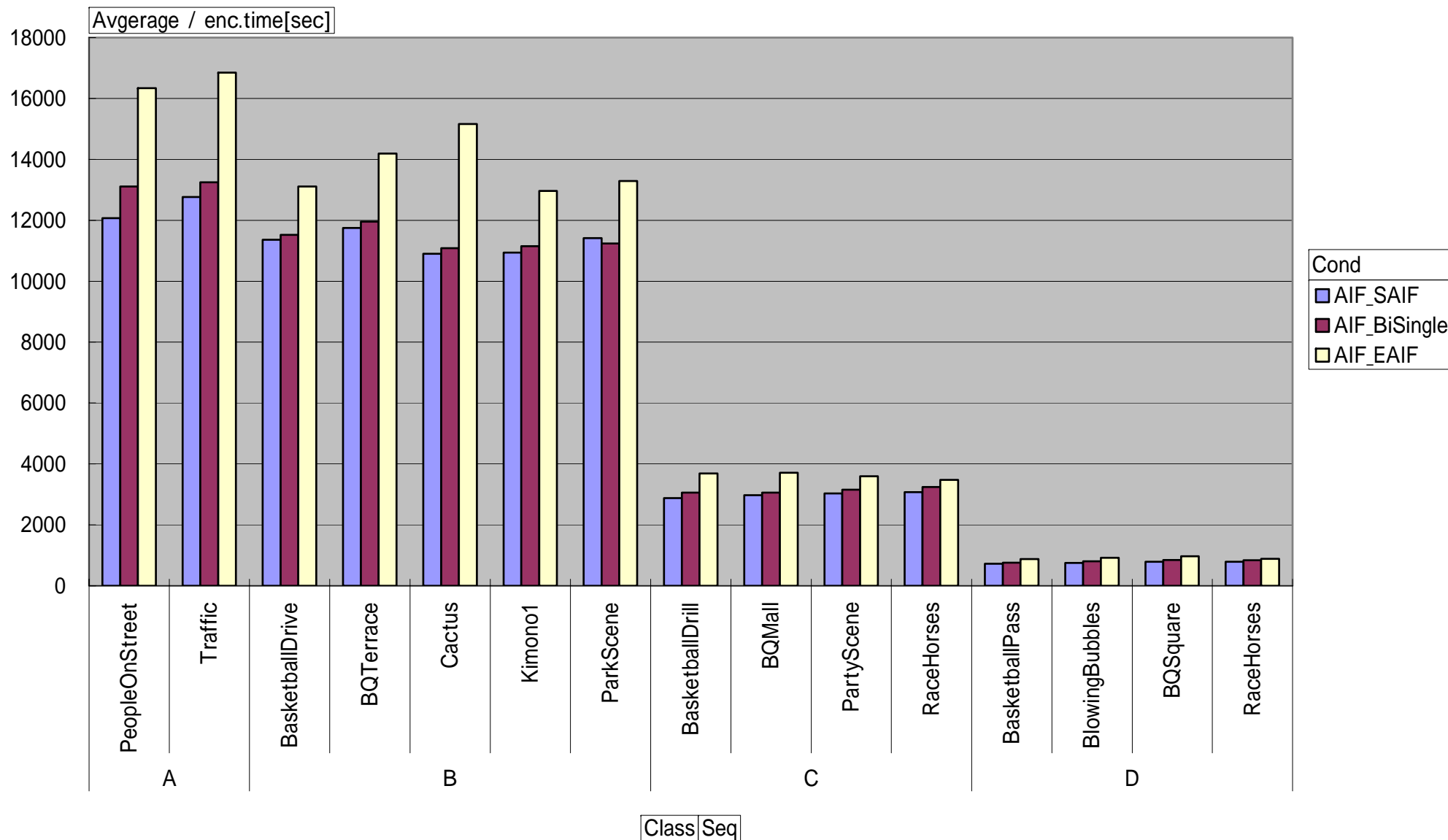
Cs c2 Rate (すべて)



AIF KTA tool off

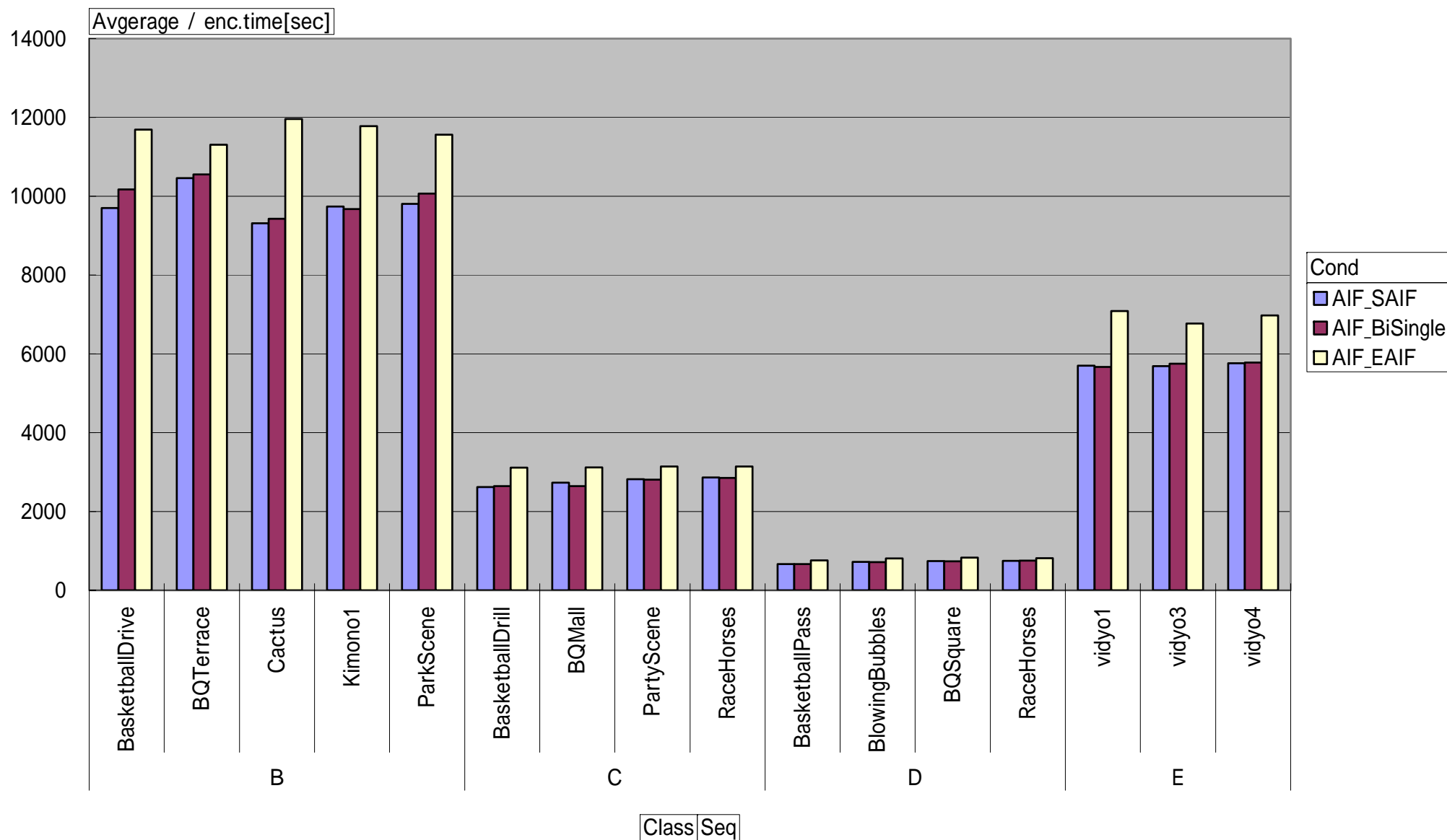
Encoder simulation time (SAIF, CS1)

Rate (すべて) Cs c1



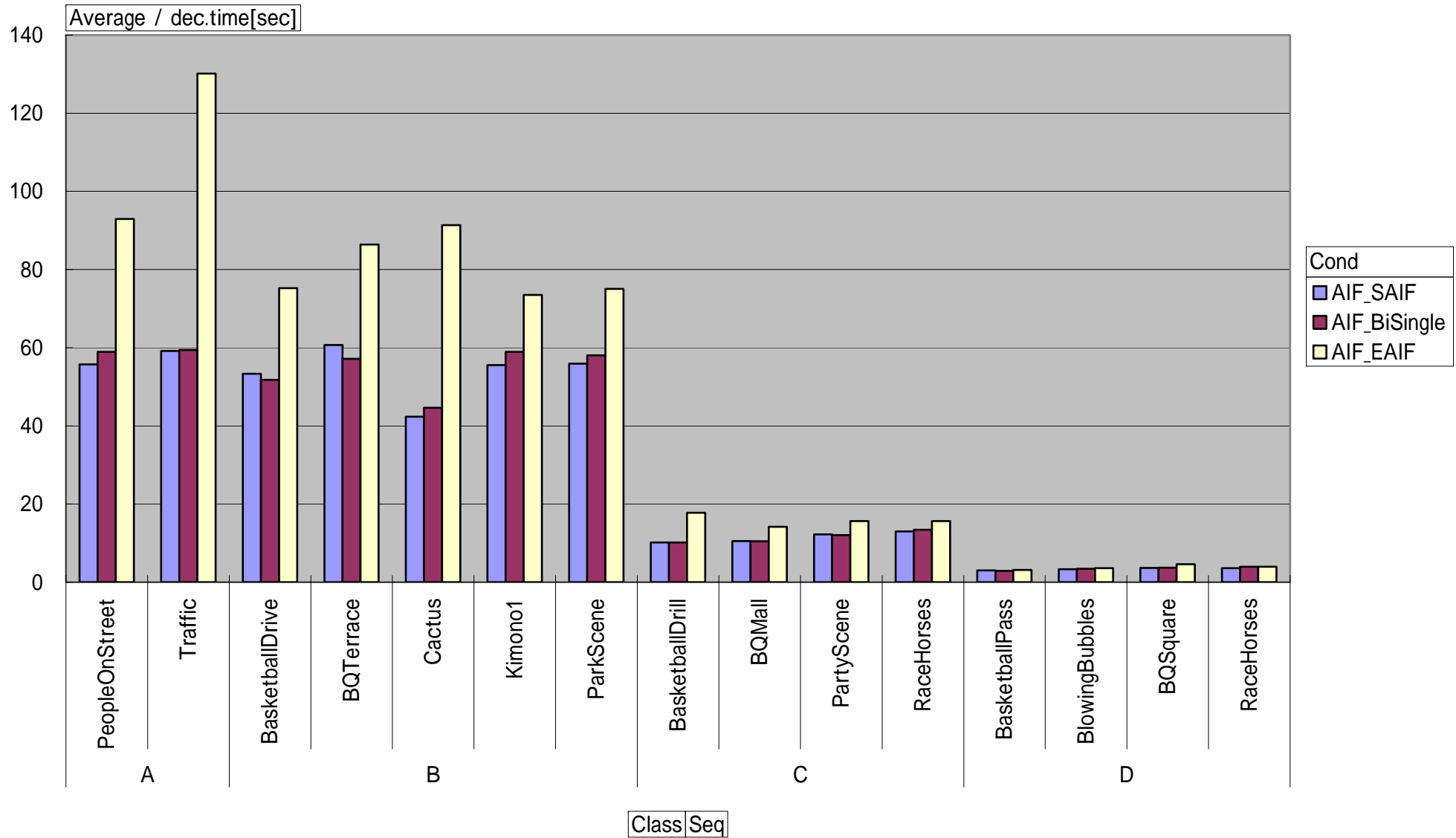
Encoder simulation time (SAIF, CS2)

Rate (すべて) Cs c2



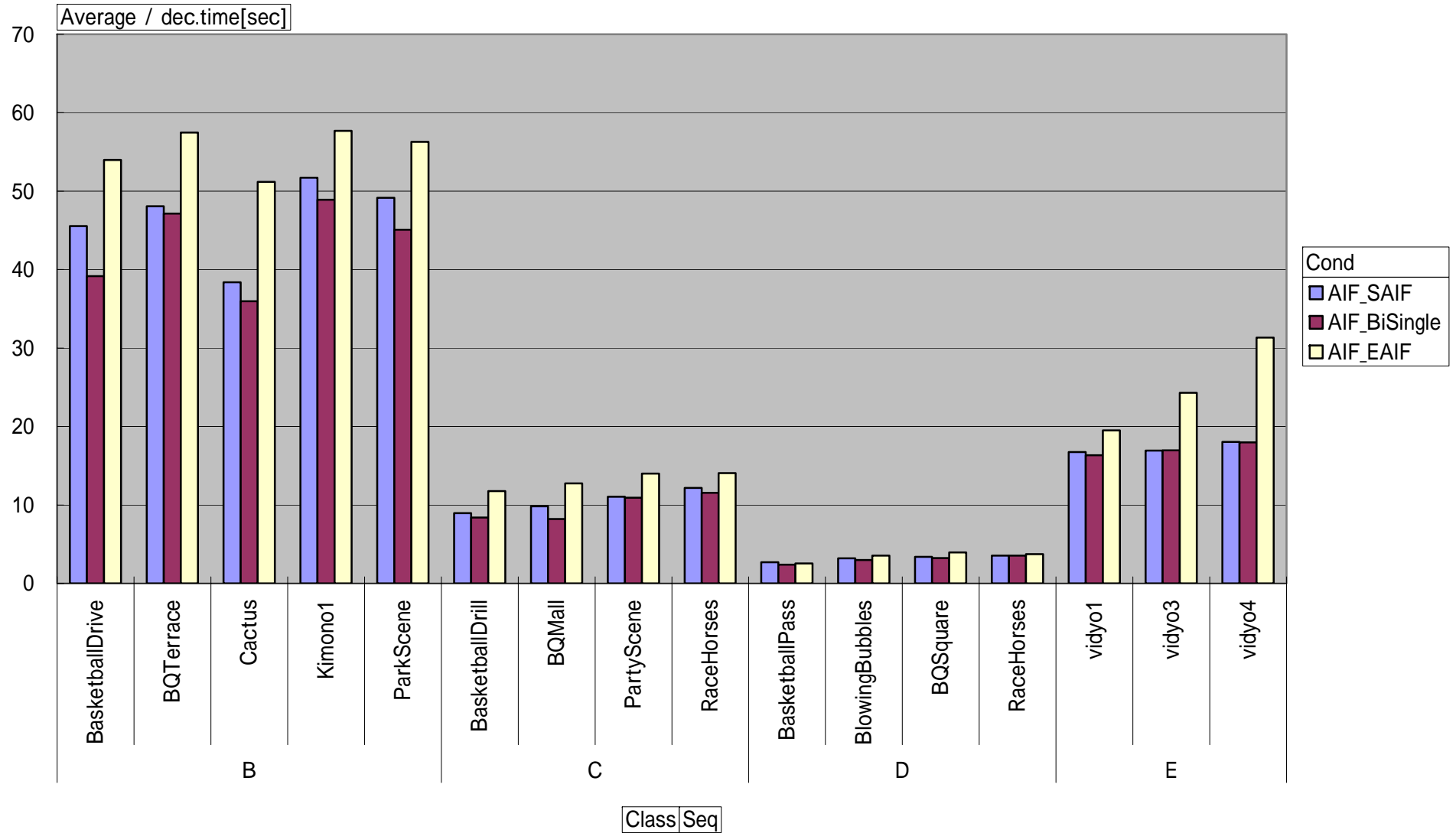
Decoder simulation time (SAIF, CS1)

Rate (すべて) Cs c1



Decoder simulation time (SAIF, CS2)

Rate(すべて)Cs c2



Conclusions

- More detail information on Bi/Single filter switching is provided
- Bi/Single filter switching can improve coding efficiency for B-picture with reasonable complexity
- This method can be applied to various interpolation methods, e.g. SIFO, 1/8 pel, 1/12 pel, 8 tap, or 12 tap
- Propose CE/TE to test this method is proposed.