Comparison Study of JM and Intel IPP H.264 Encoder

Project Presentation

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JM software

- Input file is encoder.cfg

  - input sequence
  - bit rate (The number of bits allowed to be used for compressing audio or video every second)
  - Quantization parameter
  - profile
  - frame rate
  - source width, height
  - YUV format
  - number of reference frames
  - output bit stream sequence

Intel IPP

- Input file is h264.par

  - input sequence
  - bit rate
  - profile
  - frame rate
  - source width, height
  - YUV format
  - number of reference frames
  - speed/quality grade [0,3] (0-maximum speed, 3-maximum quality)

- foreman_qcif.yuv - 11.138 MB

  - QCIF format – 176 x 144
  - YUV – 4:2:0
  - Frames encoded – 300
  - Intra Period - 15
  - Profile – baseline
  - Bit rate – 25 KB to 150 KB/sec (Input to encoder)
  - Quantization parameter– 28
 - No of reference frames - 5

foreman30_qcif_300.yuv (11.138 MB)

| Bit rates used (JM)	Motion estimation time (sec)	Total encoding time (sec)	Decoding time (sec)	H.264 file size	Compression ratio
25 KB /sec	1396.664	1658.874	15.824	251 KB	44.37
50 KB / sec	1426.045	1829.835	18.384	501 KB	22.23
75 KB / sec	1442.001	1951.315	19.059	751 KB	14.83
100 KB / sec	1376.785	1941.312	17.805	1.001 MB	11.12
125 KB / sec	1398.593	2045.541	19.375	1.251 MB	8.90
150 KB / sec	1509.317	2280.951	19.307	1.501 MB	7.42

foreman30_qcif_300.yuv (11.138 MB)

Bit rates used (Intel IPP)	Motion estimation time (sec)	Total encoding time (sec)	Decoding time (sec)	H.264 file size	Compression ratio
25 KB /sec	2.51	3.41	0.1257	294 KB	37.92
50 KB / sec	2.58	3.31	0.1519	562 KB	19.82
75 KB / sec	3.07	3.93	0.1061	824 KB	13.52
100 KB / sec	2.88	3.74	0.1232	1.082 MB	10.3
125 KB / sec	2.94	3.77	0.1386	1.334 MB	8.35
150 KB / sec	3.25	4.13	0.1577	1.583 MB	7.04

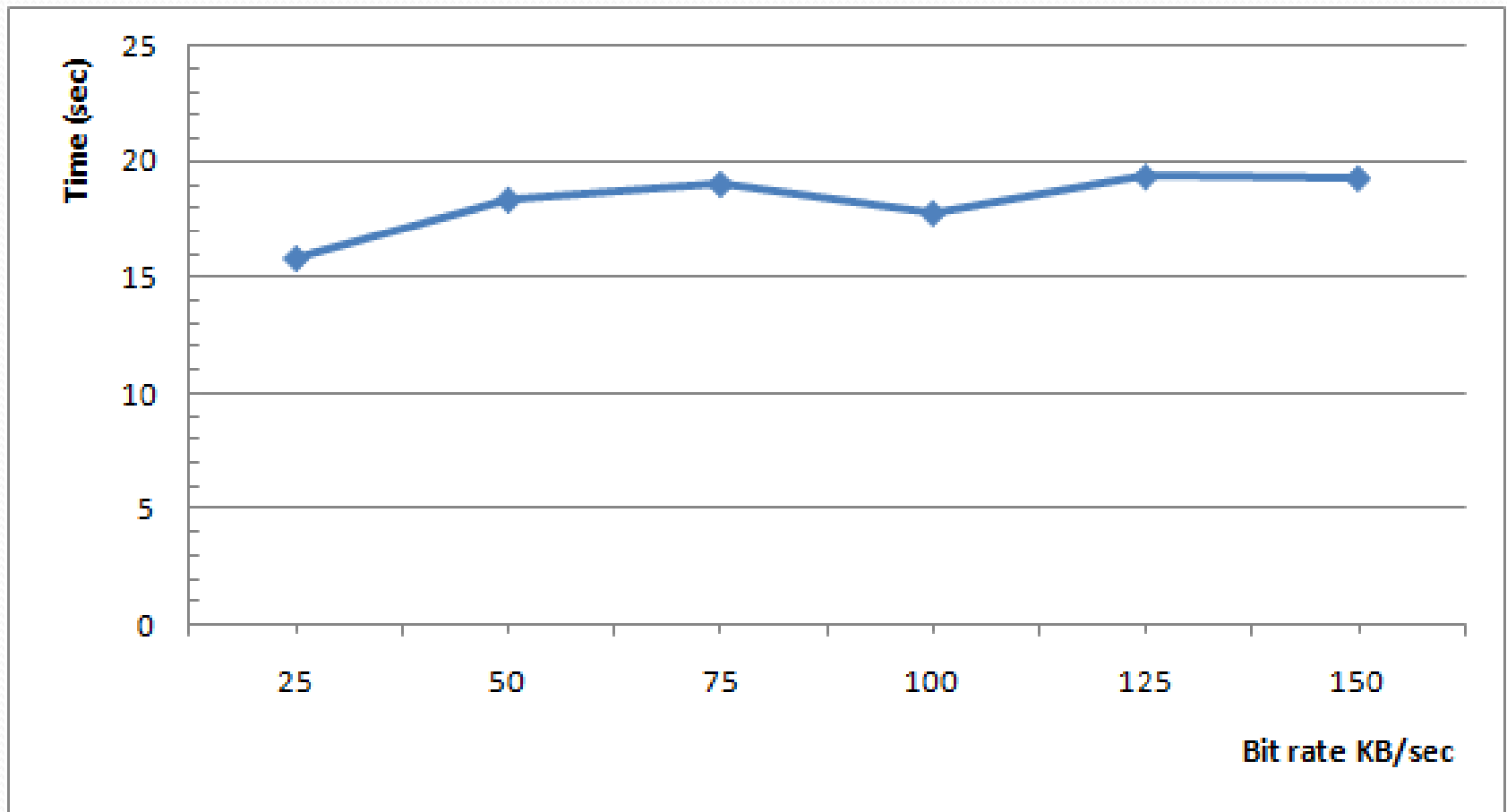# Encoding time and ME time of JM encoder at variable bit rates
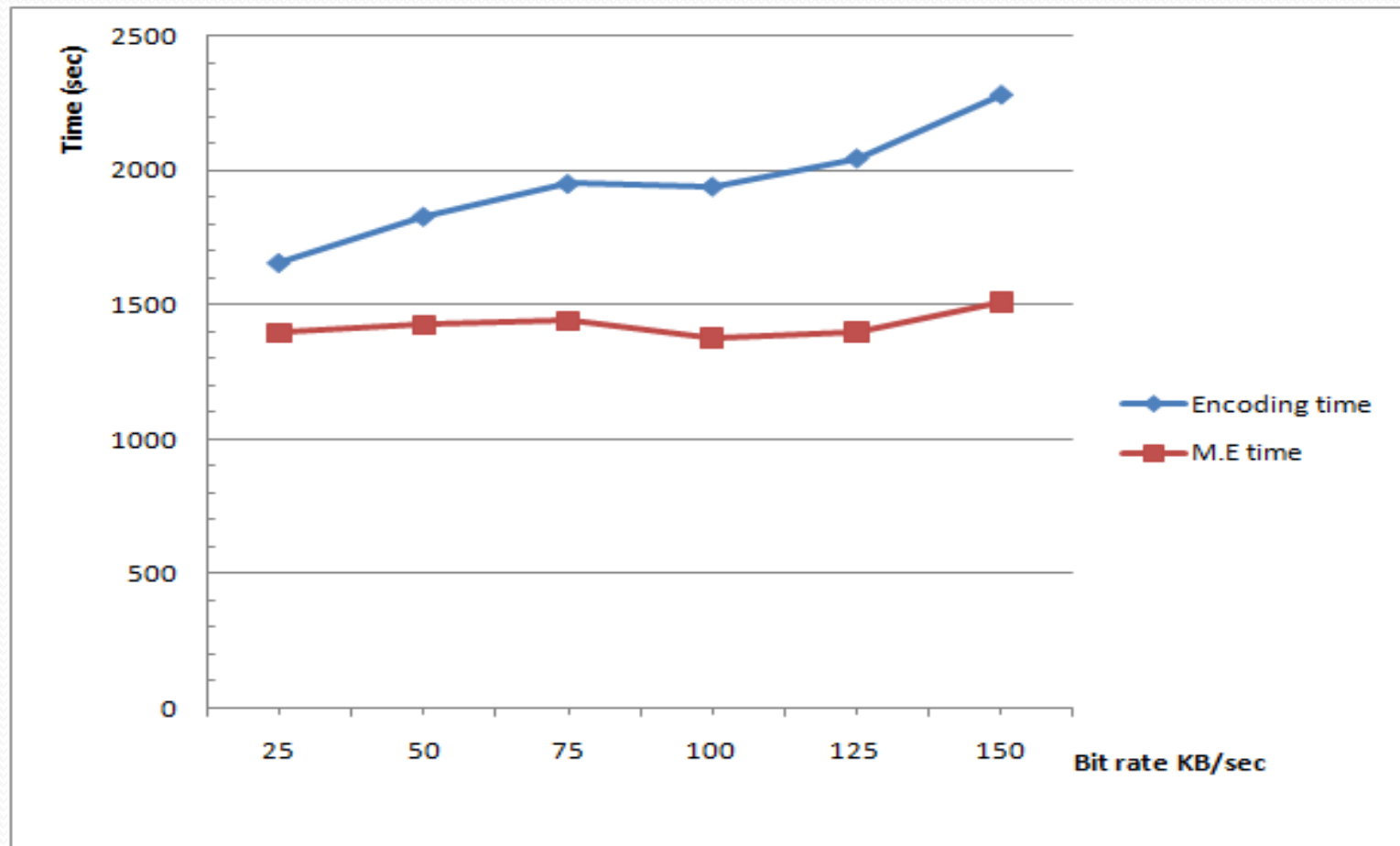
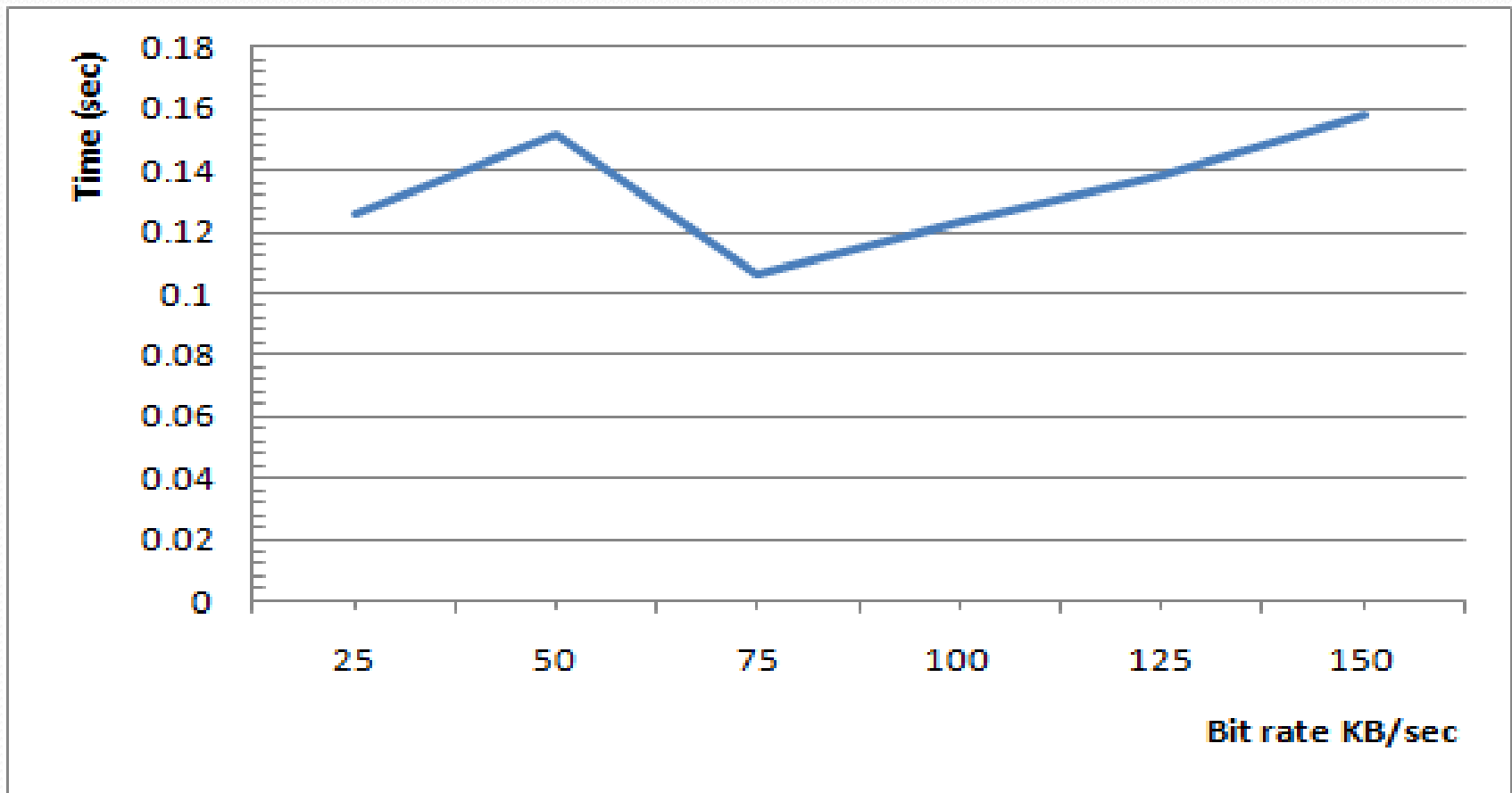# Encoding time and ME time of Intel IPP encoder at variable bit rates
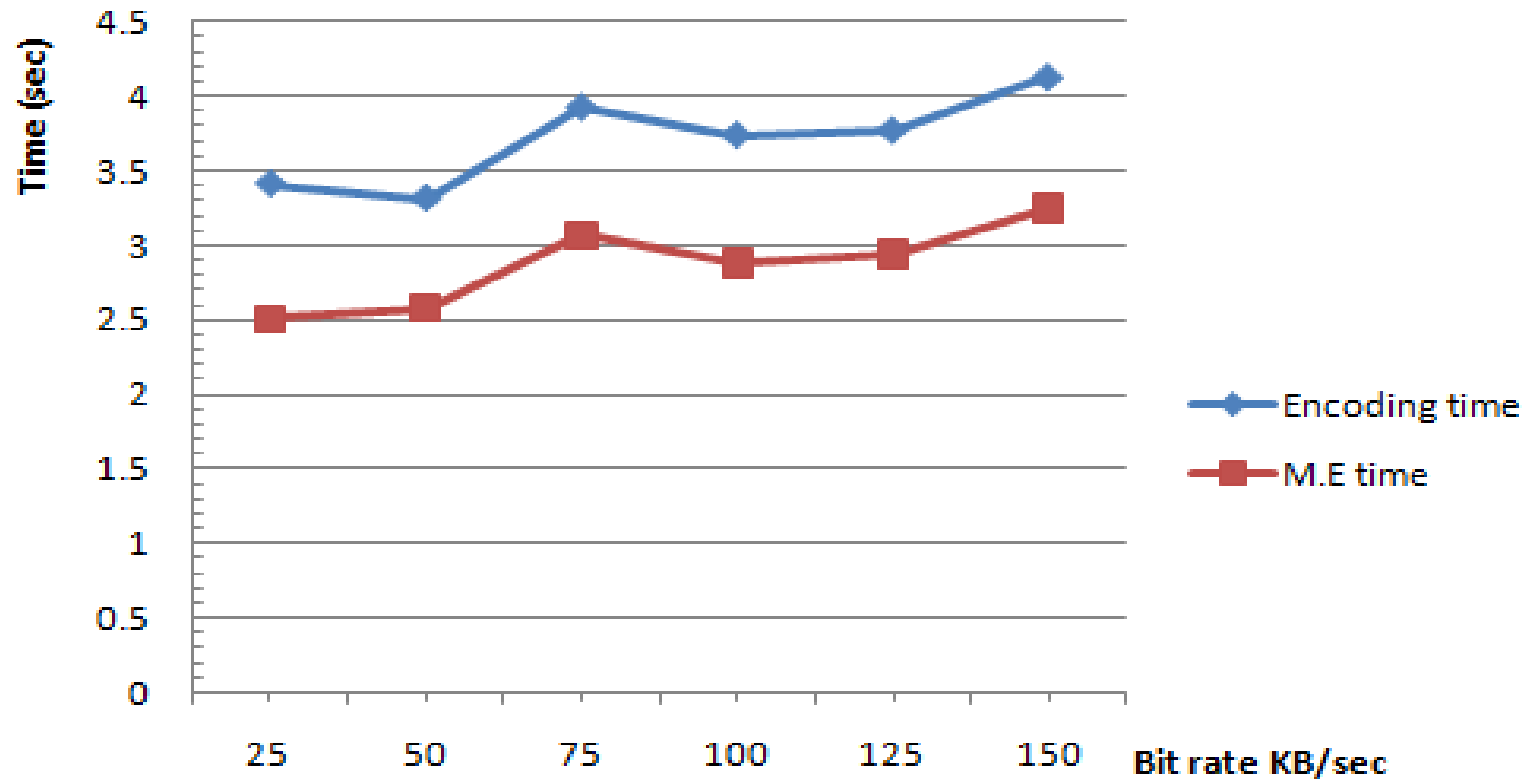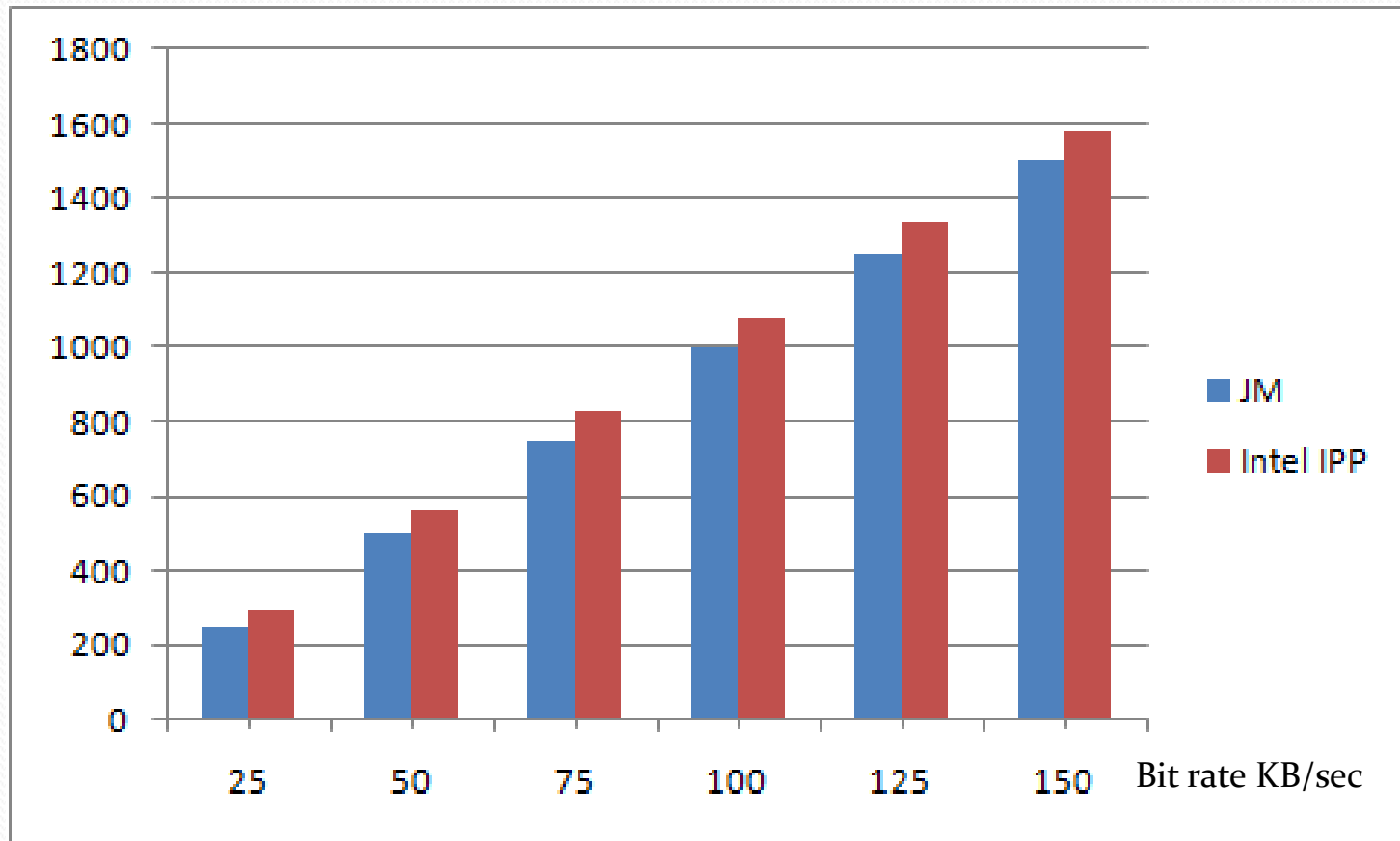
Decoding time of JM at variable bit rates

Decoding time of Intel IPP at variable bit rates
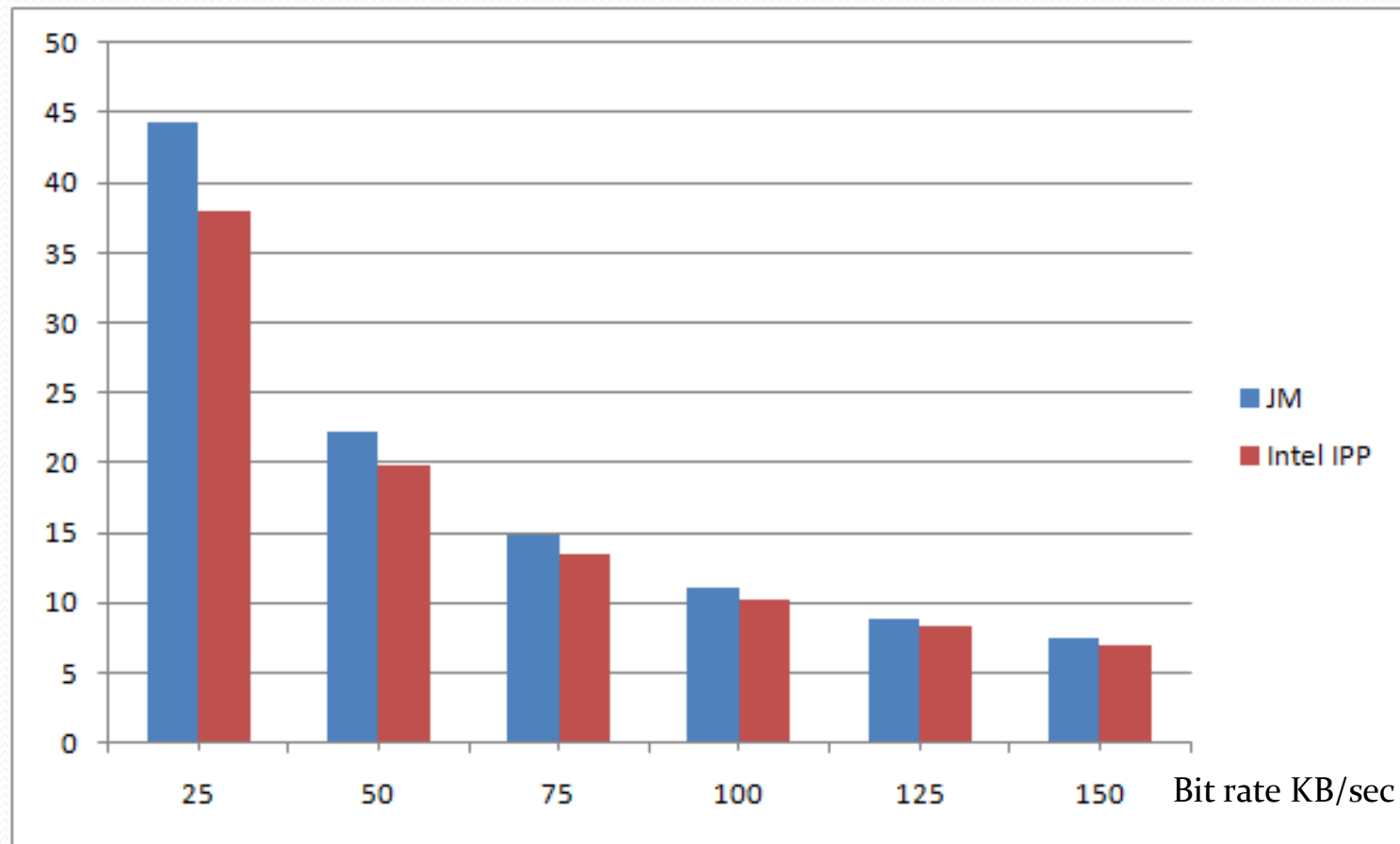
# H.264 file size comparison at various bit rates

H.264
file size
(KB)

Compression ratio (original sequence size to H.264 file size) in JM and Intel IPP for various bit rates

Bit rate KB/sec

SSIM

Bit rate	SSIM value	
	JM	Intel IPP
25 KB /sec	0.9609	0.96297
50 KB / sec	0.98146	0.98186
75 KB / sec	0.98789	0.98876
100 KB / sec	0.99063	0.99221
125 KB / sec	0.99227	0.99419
150 KB / sec	0.9934	0.99546

SSIM vs bit rates

SSIM
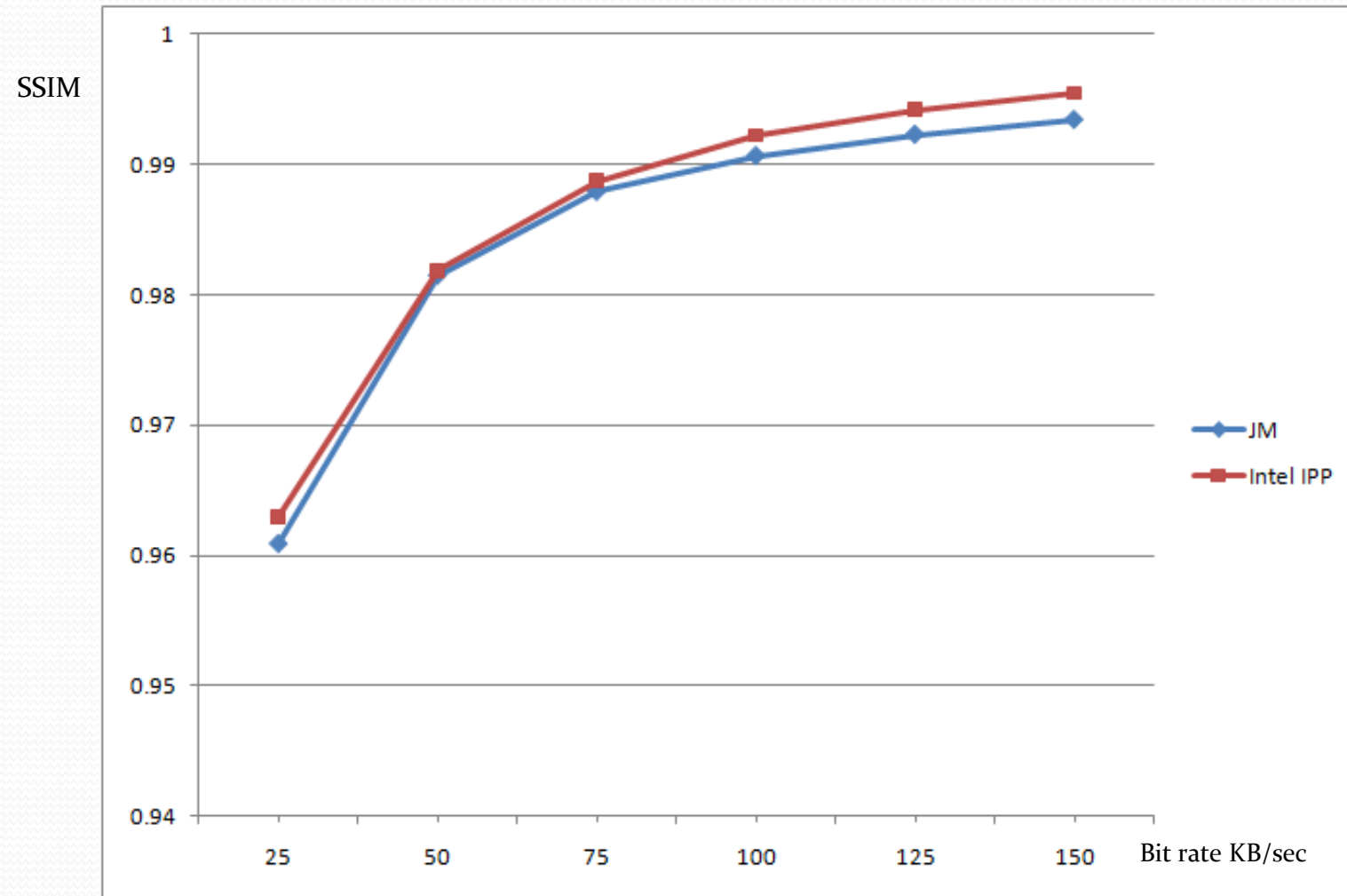
Bit rate KB/sec

PSNR

Bit rate	PSNR in dB	
	JM	Intel IPP
25 KB /sec	37.18359	37.46751
50 KB / sec	41.13141	41.28917
75 KB / sec	43.17939	43.7612
100 KB / sec	44.37394	45.63609
125 KB / sec	45.26677	47.11219
150 KB / sec	45.95815	48.34548

PSNR vs bit rates
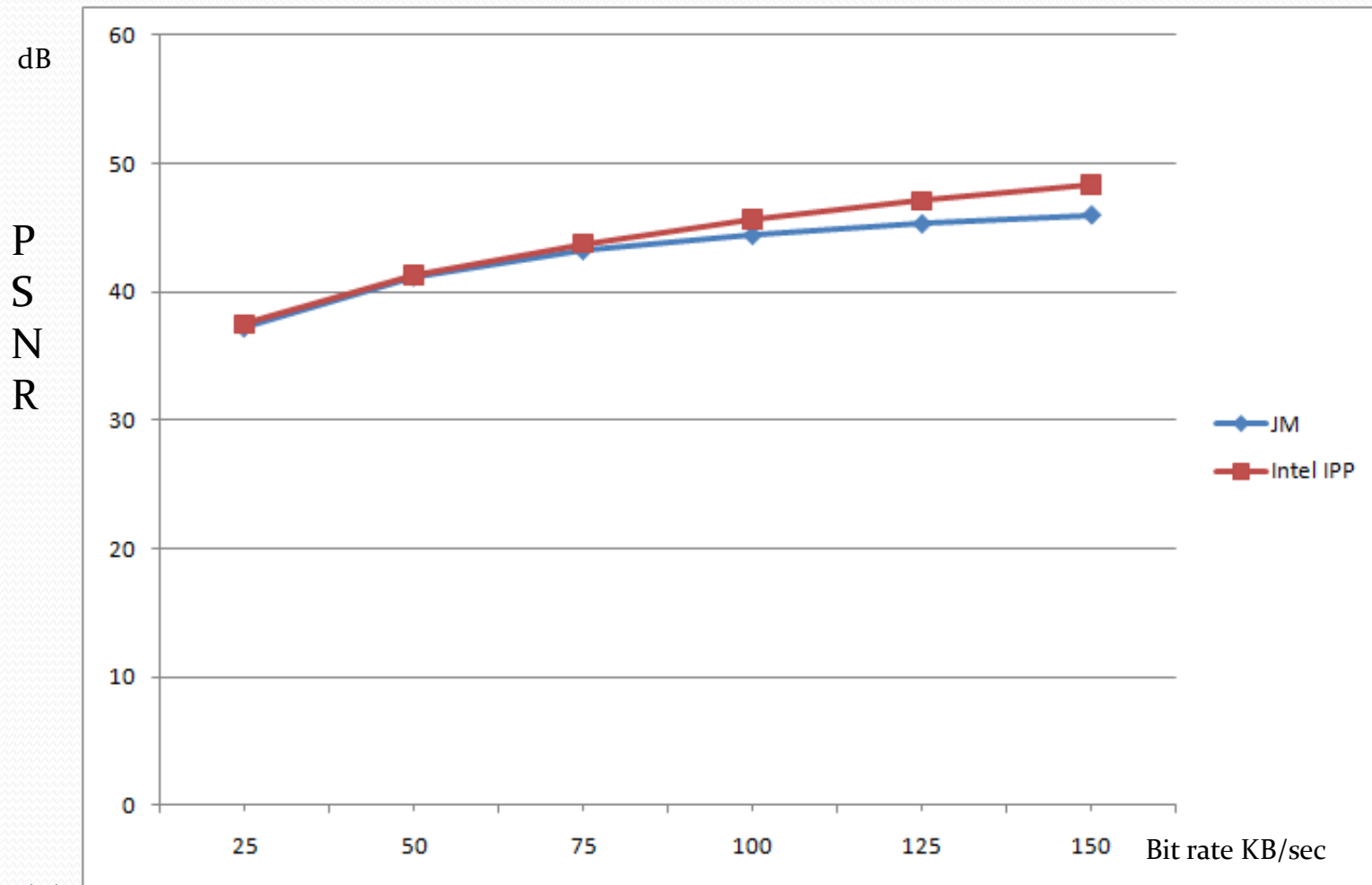
MSE

Bit rate	MSE	
	JM	Intel IPP
25 KB /sec	12.43717	11.6501
50 KB / sec	5.01117	4.83241
75 KB / sec	3.1271	2.73502
100 KB / sec	2.37513	1.77612
125 KB / sec	1.93376	1.26433
150 KB / sec	1.64917	0.95177

MSE vs bit rates
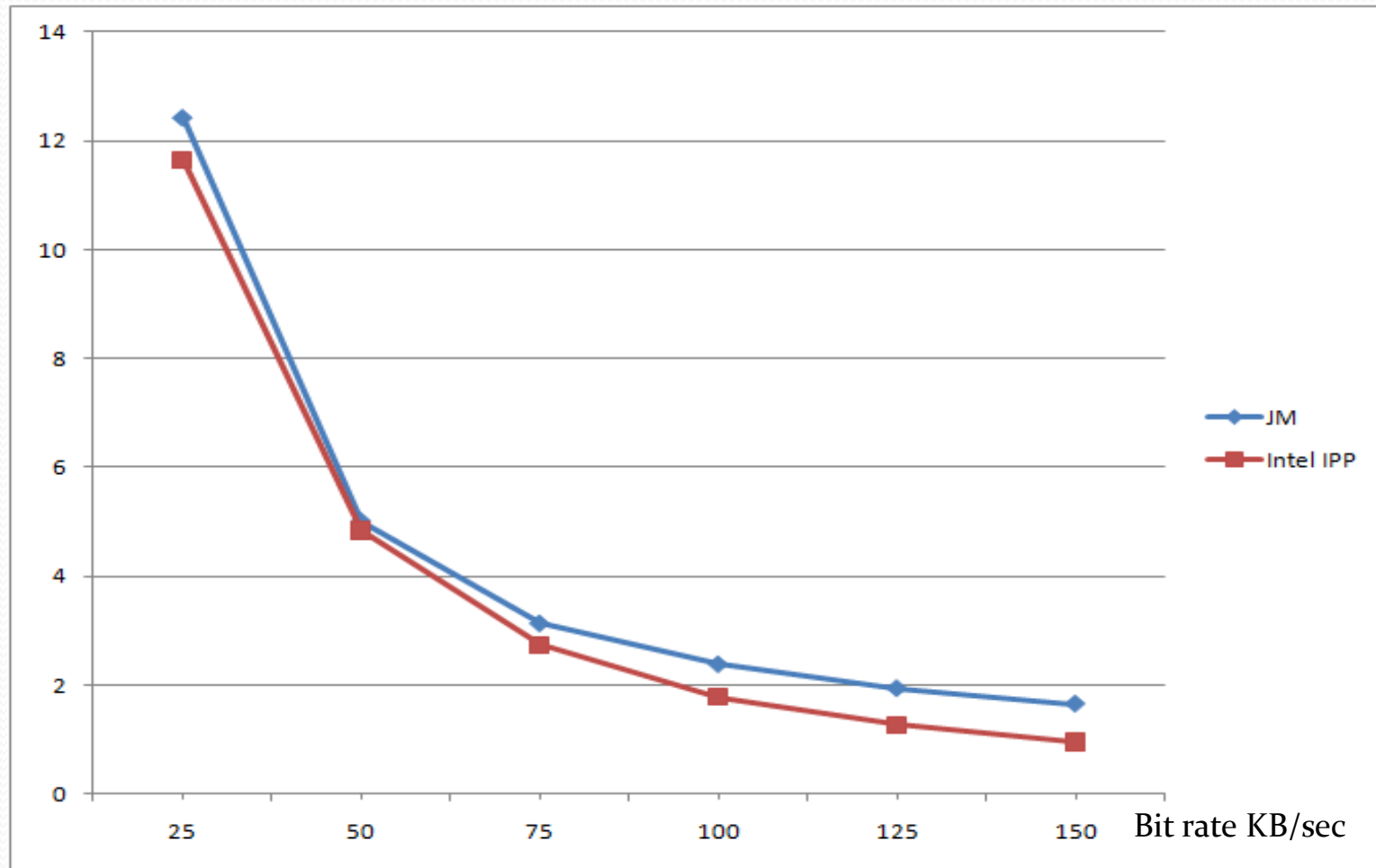
- football.yuv – 13 MB

  - CIF format – 352x288
  - YUV – 4:2:0
  - Frames encoded – 90
  - Intra Period - 15
  - Profile – baseline
  - Bit rate – 25 KB to 150 KB/sec (Input to encoder)
 - Quantization parameter– 28
  - No of reference frames - 5

Football30_CIF_90 (13.365 MB)

| Bit rate used (JM)	Motion estimation time (sec)	Encoding time (sec)	Decoding time (sec)	H.264 file size	Compression ratio
25 KB/sec	1867.852	1977.511	7.46	115 KB	116.21
50 KB/sec	1895.832	2011.276	8.643	151 KB	88.5
75 KB/sec	1870.535	1994.897	8.793	225 KB	59.4
100 KB/sec	1787.468	1914.402	10.001	300 KB	44.55
125 KB/sec	1762.494	1894.901	9.81	375 KB	35.64
150 KB/sec	1752.587	1889.357	10.397	450 KB	29.7

Football30_CIF_90 (13.365 MB)

| Bit rates used (Intel IPP)	Motion estimation time (sec)	Total encoding time (sec)	Decoding time (sec)	H.264 file size (KB)	Compression ratio
25 KB/sec	1.47	1.77	0.0483	88	151.87
50 KB/sec	1.96	2.27	0.0567	186	71.85
75 KB/sec	2.25	2.58	0.0642	280	47.73
100 KB/sec	2.38	2.71	0.0629	372	35.92
125 KB/sec	2.47	2.93	0.0628	465	28.74
150 KB/sec	2.53	2.86	0.0898	554	24.12

Encoding time and ME time of JM encoder at variable bit rates
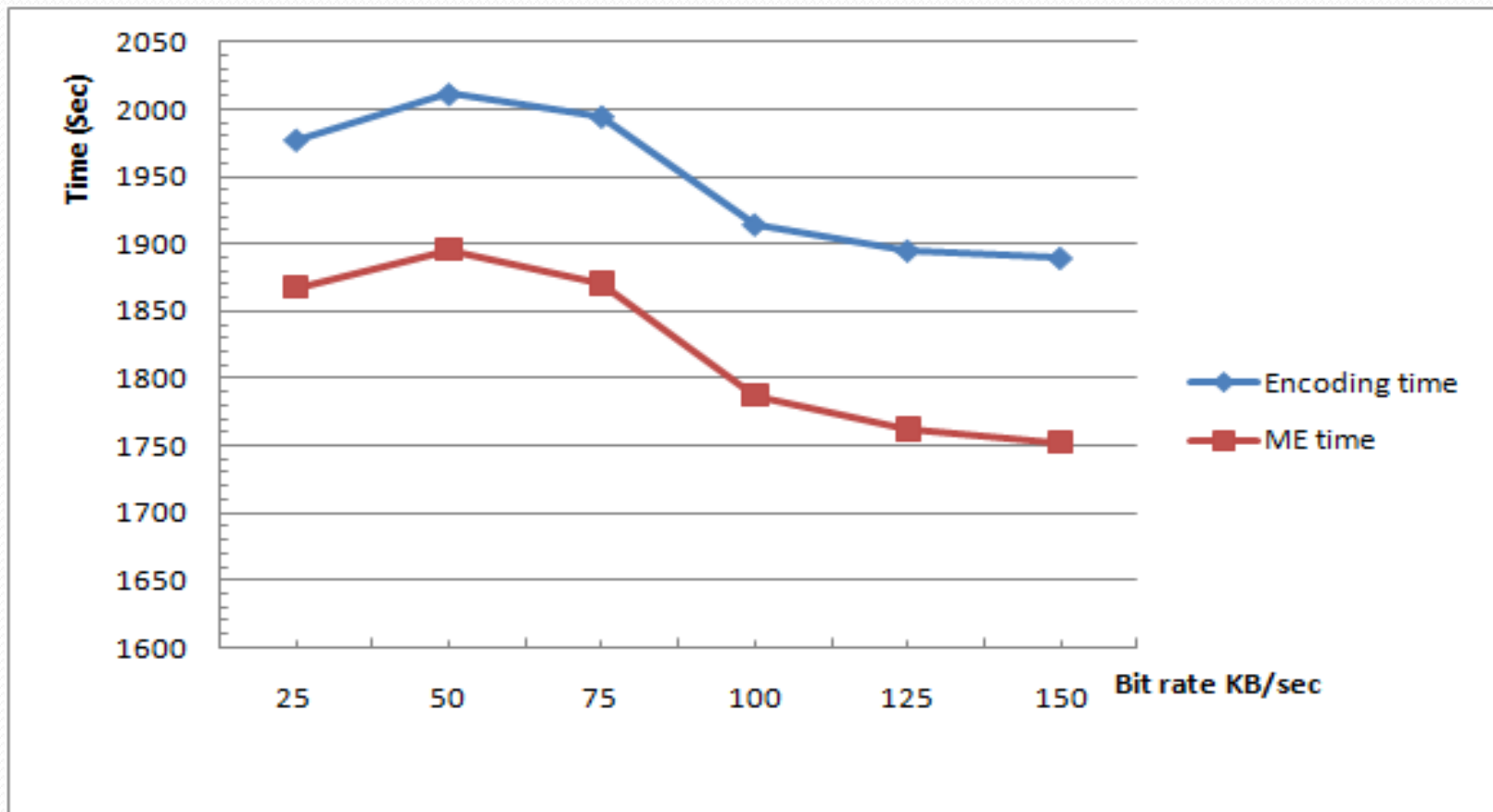
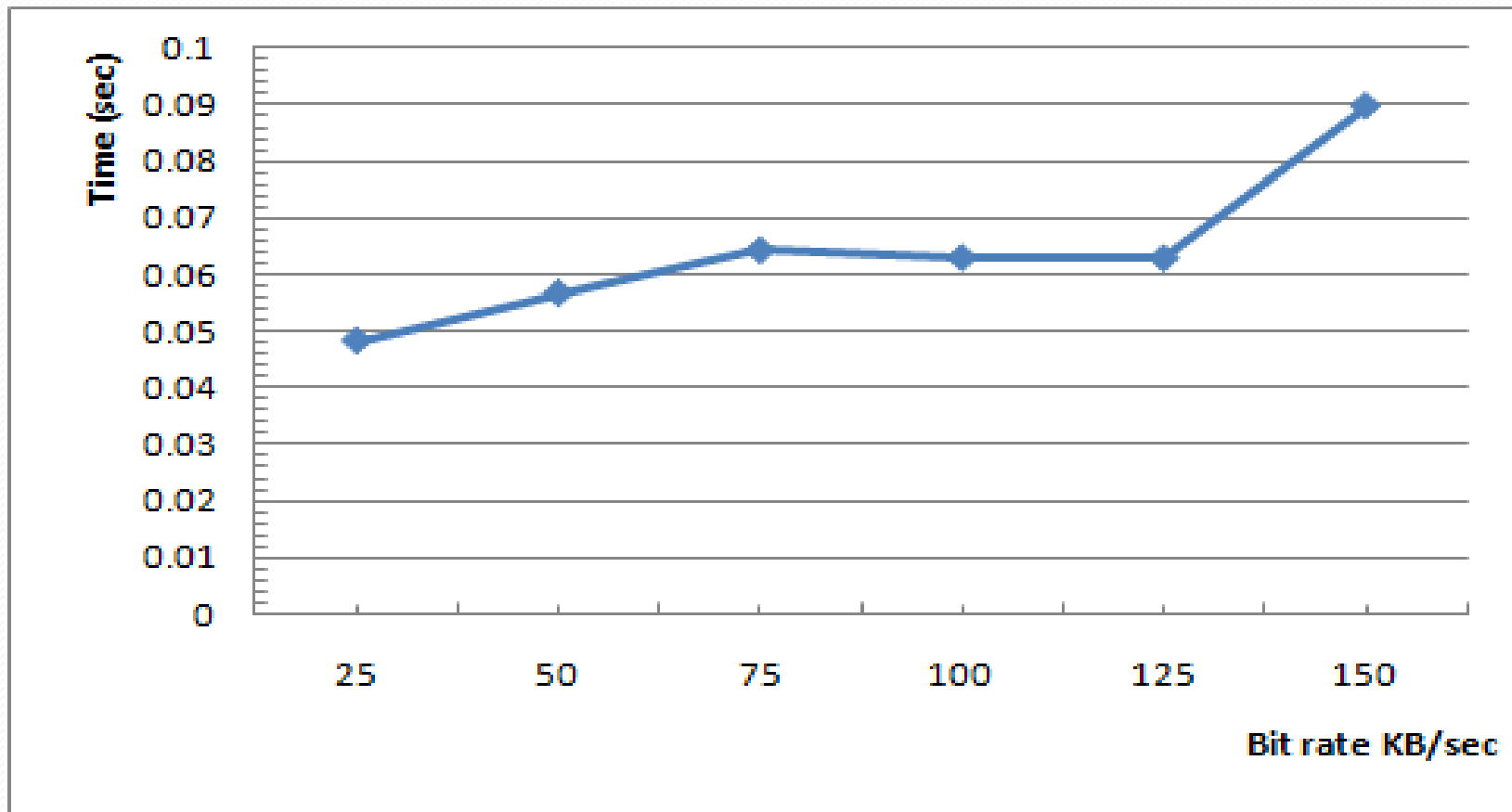# Encoding time and ME time of Intel IPP encoder at variable bit rates
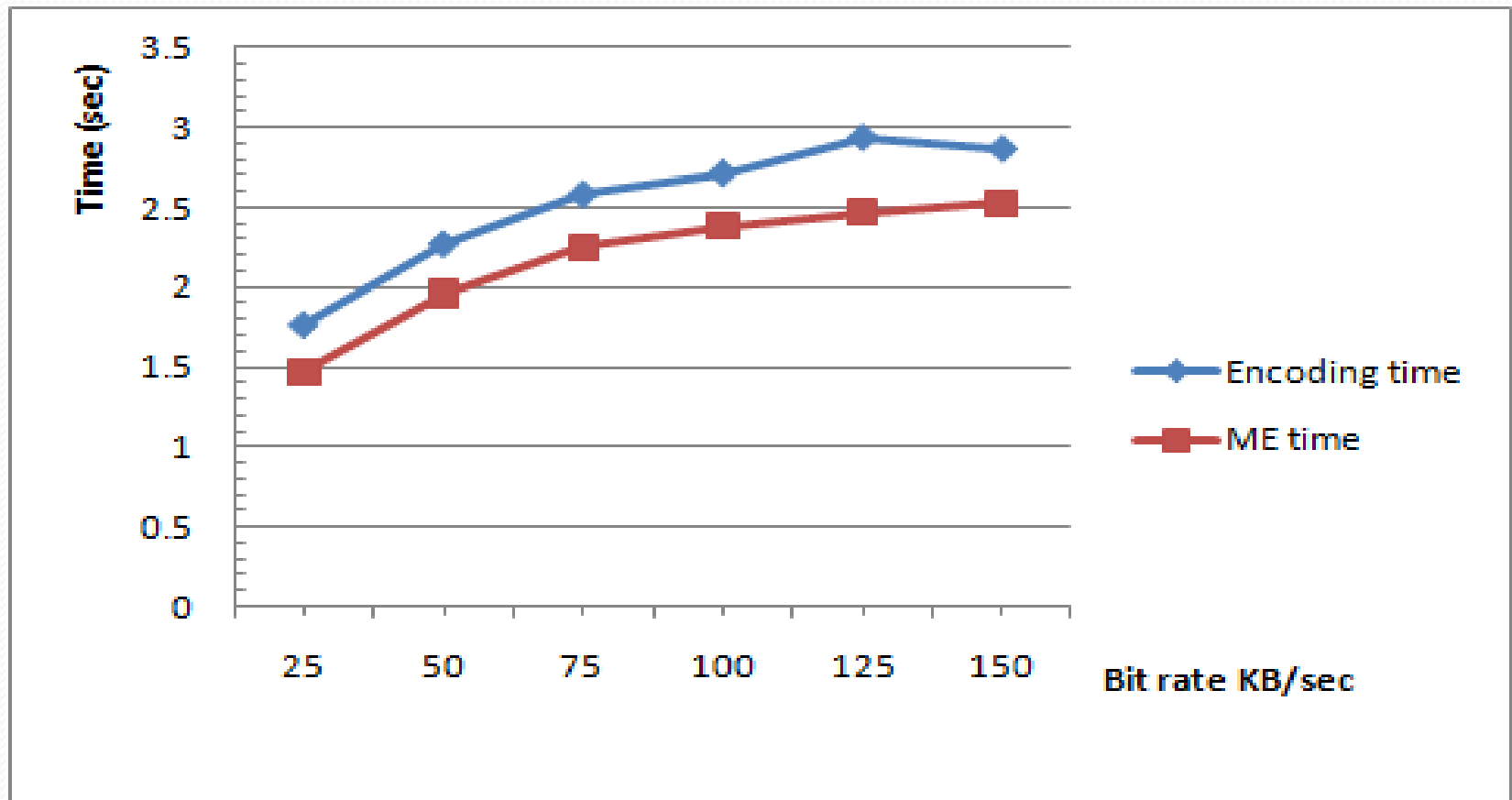
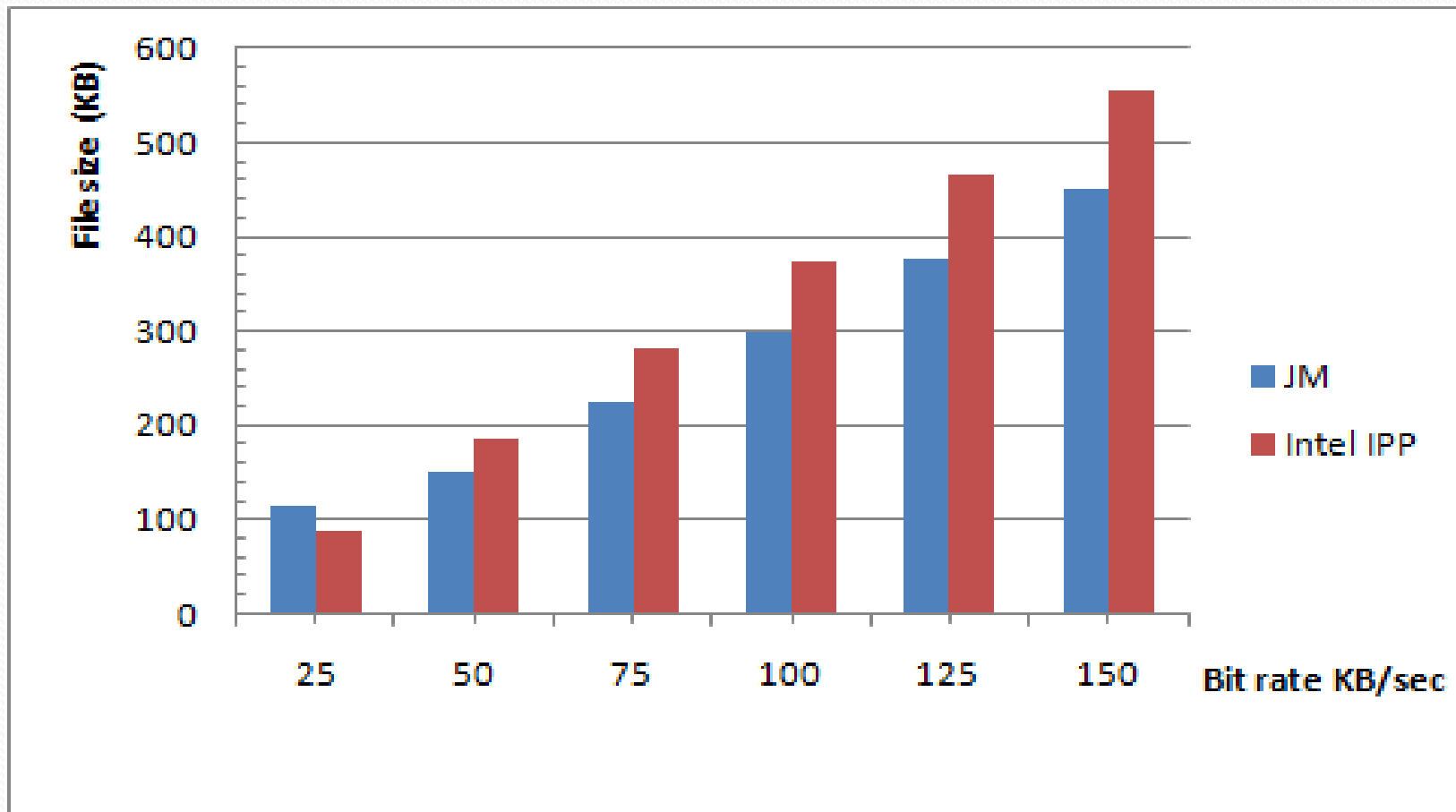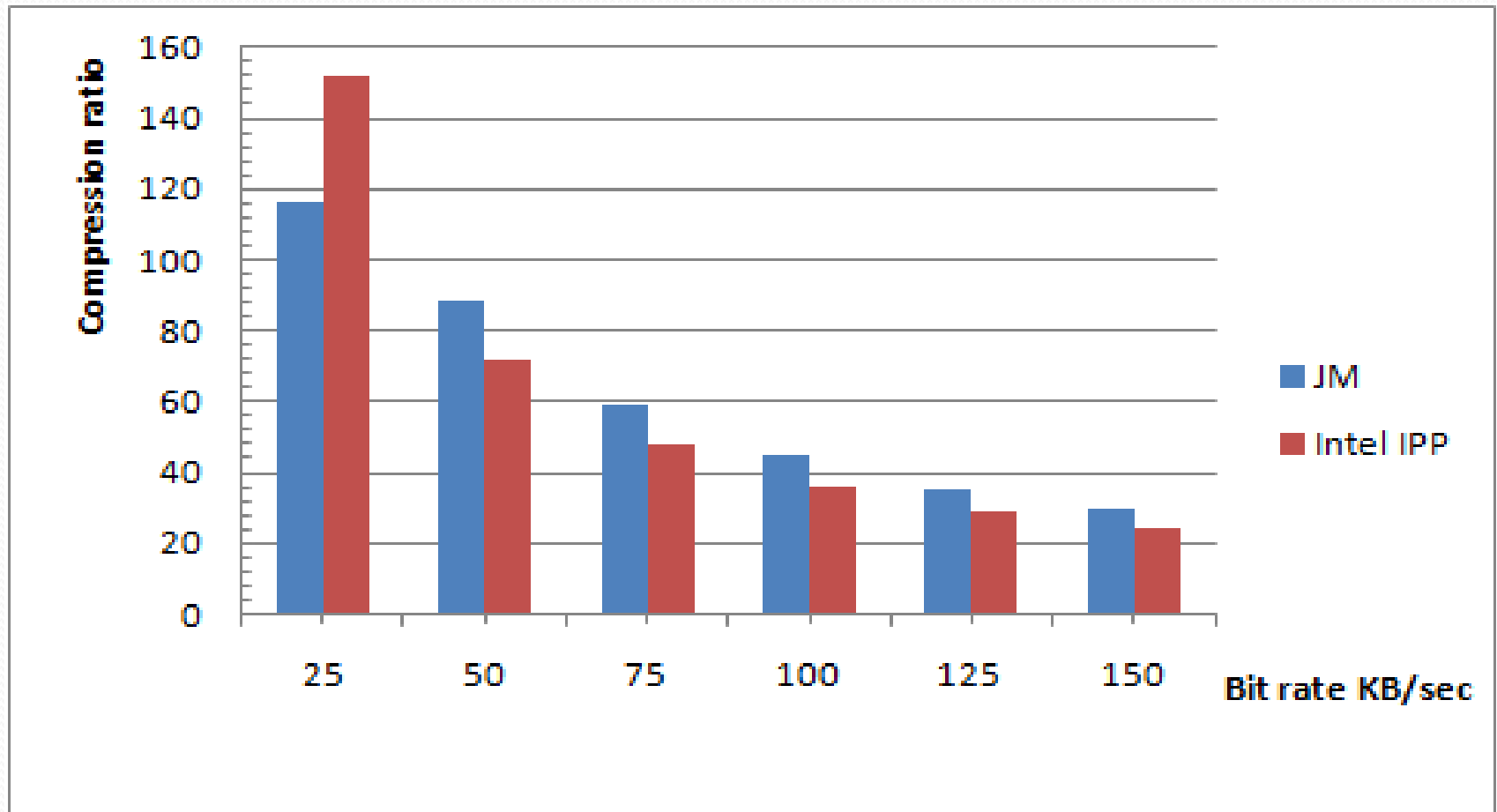# Decoding time of JM at variable bit rates
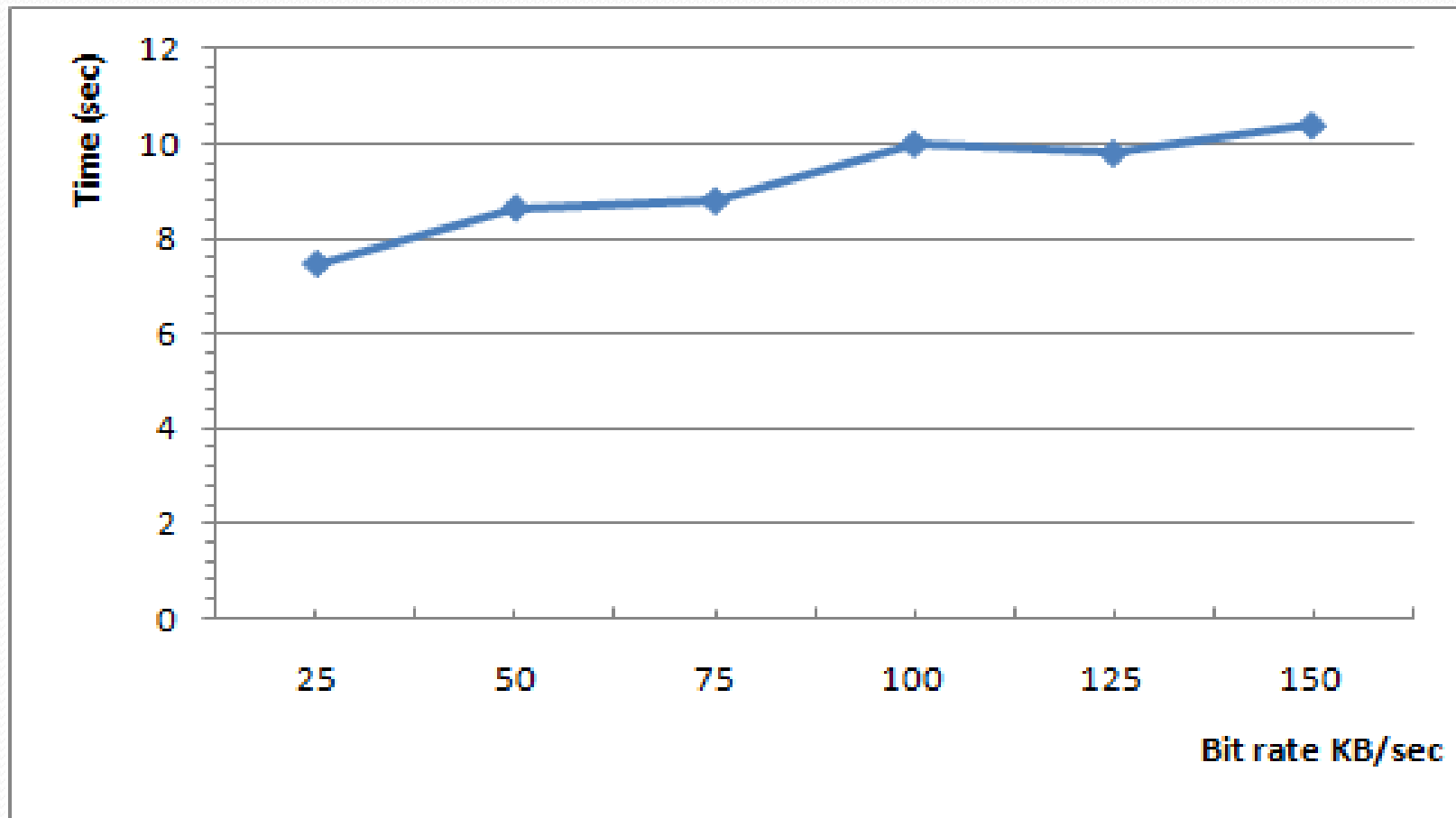
Decoding time taken by Intel IPP at variable bit rates
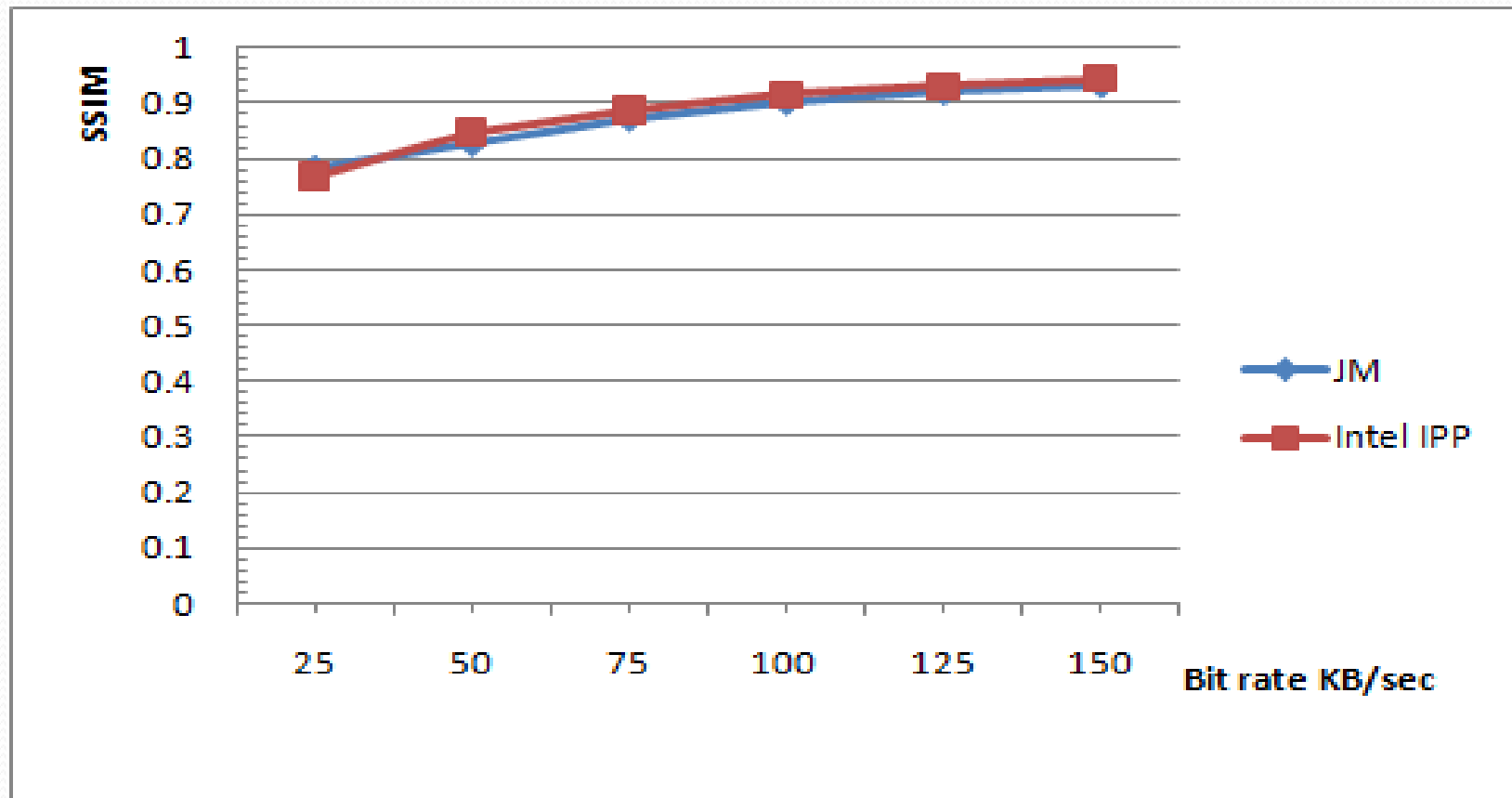
H.264 file size at different bit rates

Compression ratio comparison at variable bit rates

SSIM

Bit rate	JM	Intel IPP
25 KB/sec	0.78131	0.76785
50 KB/sec	0.82761	0.8471
75 KB/sec	0.8734	0.8876
100 KB/sec	0.90238	0.91482
125 KB/sec	0.92068	0.93117
150 KB/sec	0.93351	0.94339

SSIM comparison at variable bit rates

PSNR

bit rate (KB/sec)	JM (PSNR in dB)	Intel IPP (PSNR in dB)
25	29.33657	29.15126
50	30.98771	32.14291
75	33.01121	34.08814
100	34.73708	35.63852
125	36.00283	36.81034
150	37.02637	37.82698

PSNR comparison at variable bit rates
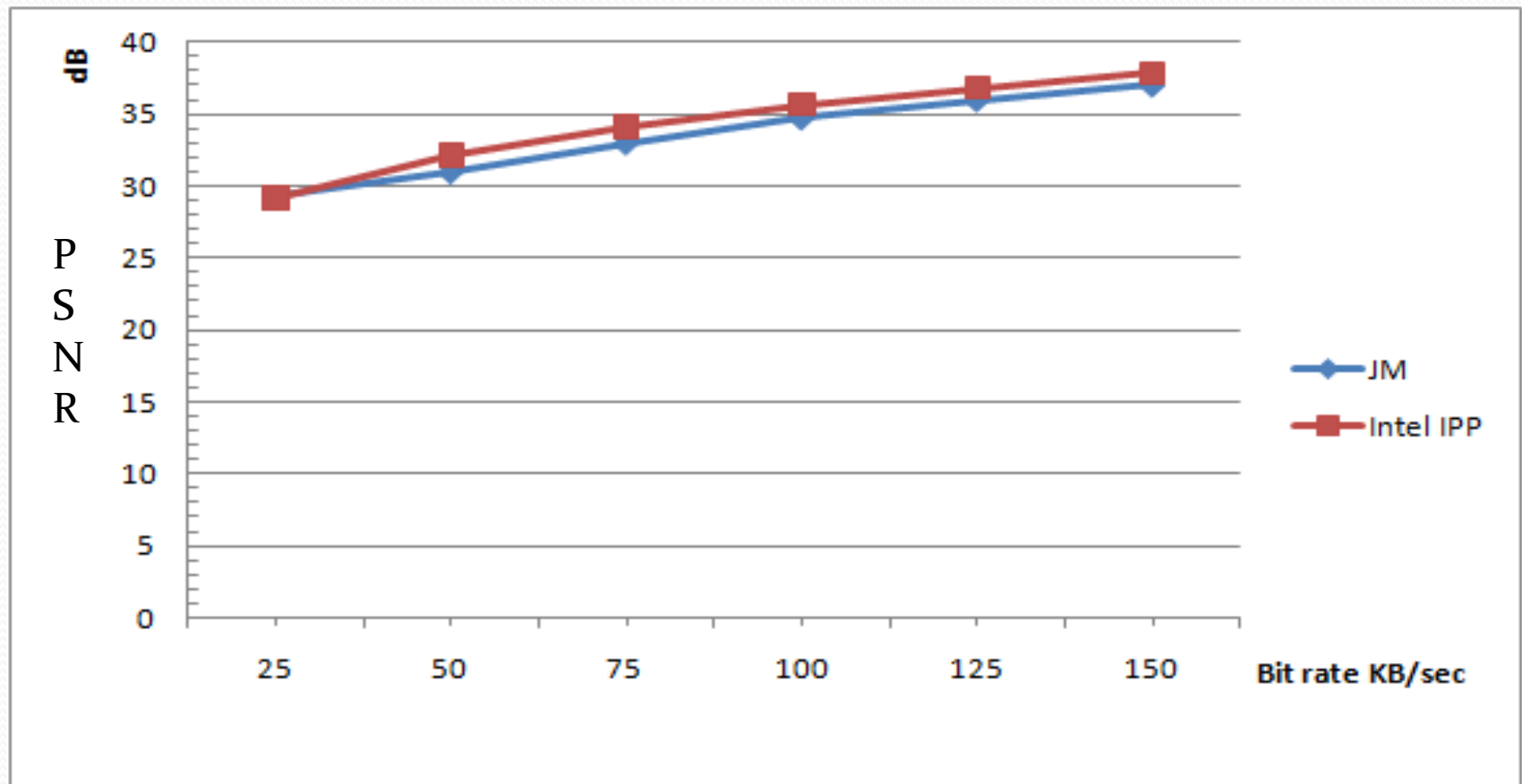
MSE

bit rate (KB/sec)	MSE of JM	MSE of Intel IPP
25	75.7571	79.05947
50	51.79758	39.69989
75	32.50572	25.36683
100	21.84603	17.75123
125	16.32292	13.55333
150	12.89565	10.72463

MSE comparsion at variable bit rates
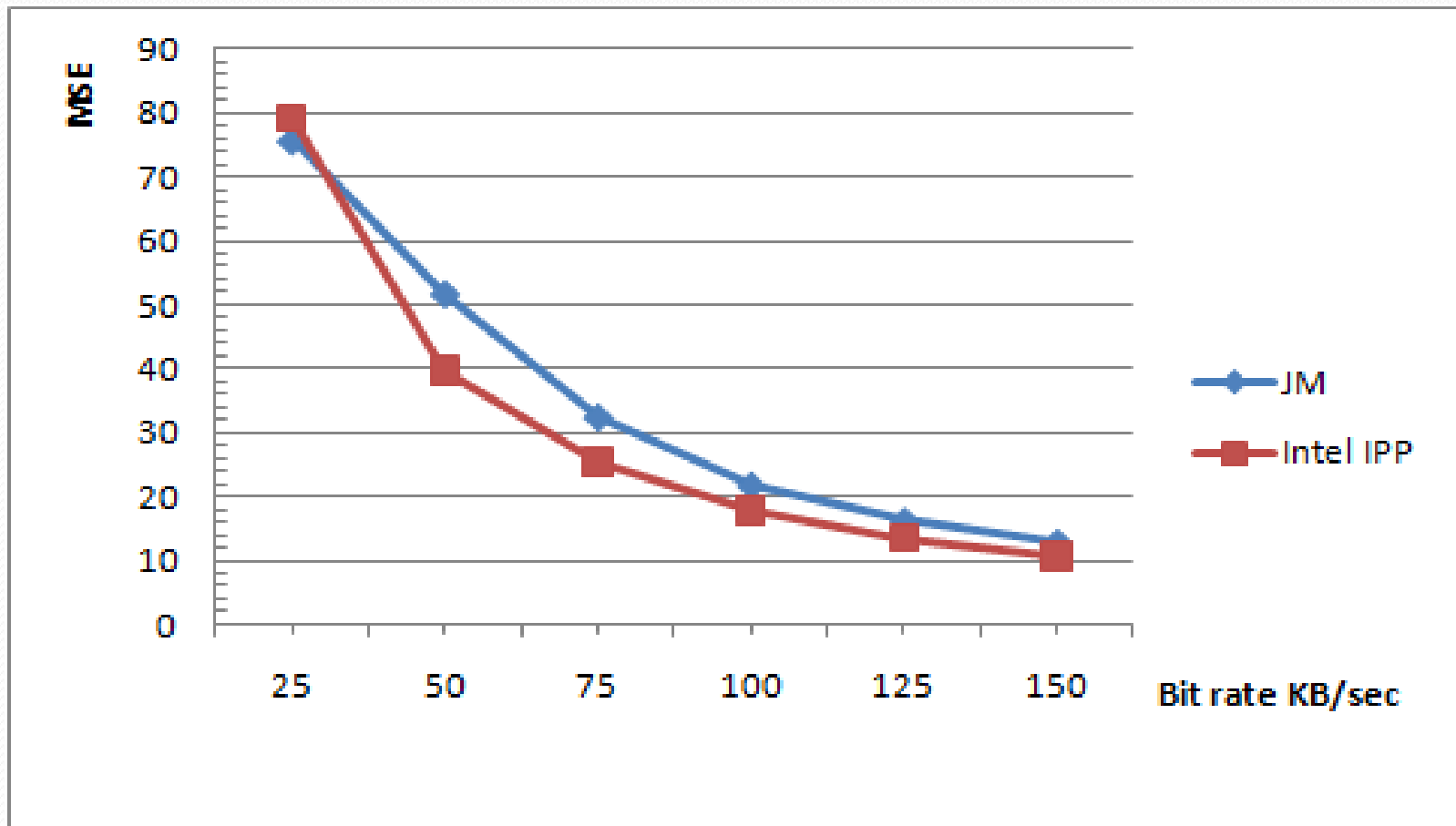
Conclusion

- The Intel IPP compiler is highly optimized and it is more than 500 times faster than the JM

  software in terms of encoding time and decoding time. The quality of the output video has

  been tested in terms of MSE, PSNR, and SSIM for different video streams namely CIF and QCIF.

  Intel IPP H.264 clearly emerges as the winner against JM H.264 in all aspects except

  compression size of H.264 file in some cases.

References

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- [2]. http://iphome.hhi.de/suehring/tml/JM%20 Reference%20Software%20Manual%20(JVT-AE010).pdf   for JM reference software documentation manual

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- [4]. http://software.intel.com/en-us/articles/intel-integrated-performance-primitives-code-samples/ for code samples

- [5]. Soon-kak Kwon, A. Tamhankar and K.R. Rao, "Overview of H.264 / MPEG-4 Part 10", J. Visual Communication and Image Representation, vol. 17, pp.186-216, April 2006.

References

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References

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- [9]. A.Luthra, G.J.Sullivan, and T.Wiegand,Eds., IEEE Trans.Circuits and Systems Video Technology. Special issue on the H.264/AVC Video coding standard, vol.13,no.7, July 2003.

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