

MSU Denoising & Noise Remover Filters

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Introduction

The first two parts introduce the results of applying three denoising filters to the video sequences. These are **MSU Noise Remover** and **MSU Denoise** filters, both developed by MSU Video Group, and **Smart Smoother 1.1** by Donald Graft. The first part shows the benefits (lowering of bitrate) of using these filters before compressing it by a codec (**DivX5** and **DivX4** were taken as an example). The second part introduces the visual comparison of frames with noise and frames after applying these denoising filters.

Main result

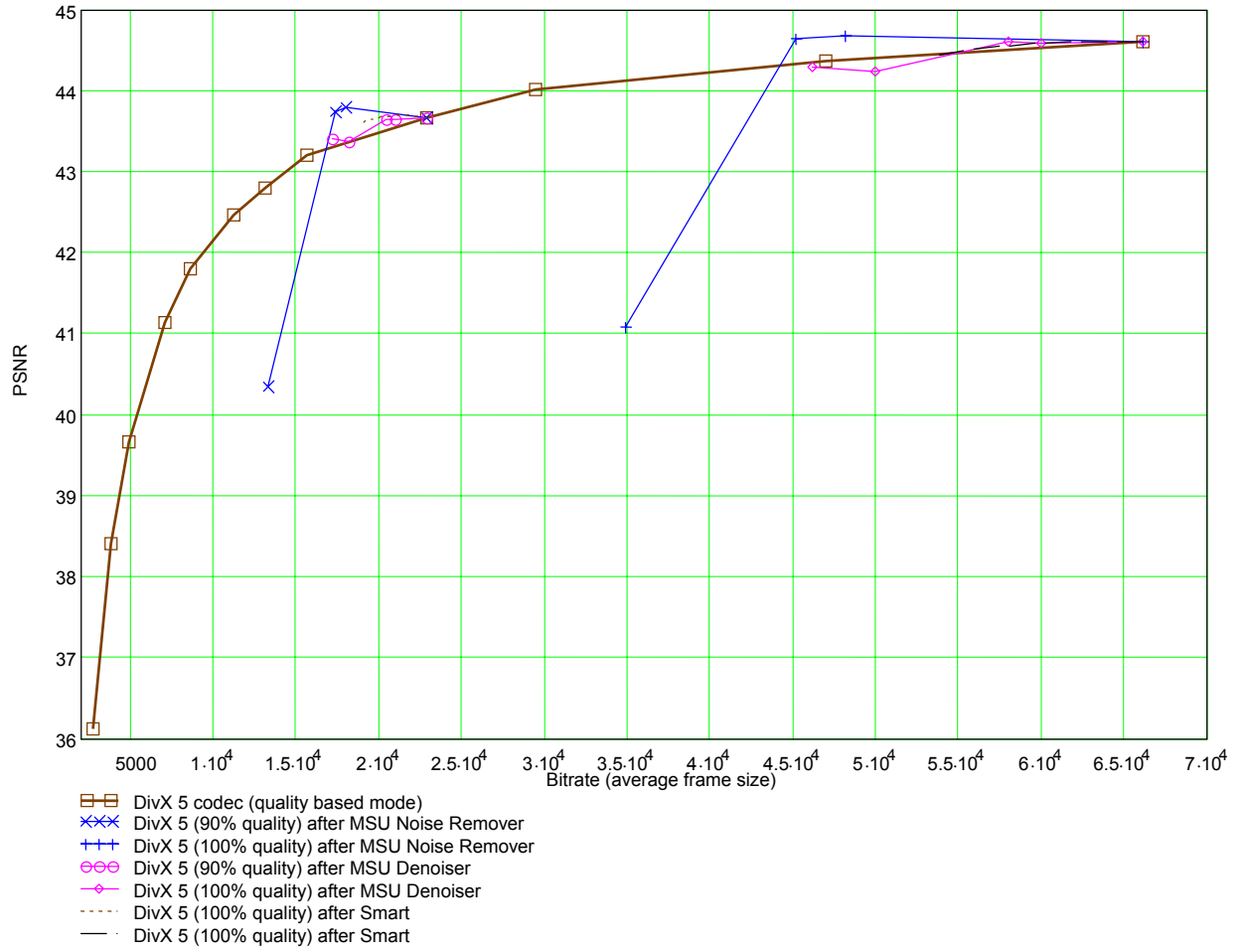
Up to 30% bigger compression with the same PSNR and better visual quality.

Part1: Denoising Filters with DivX

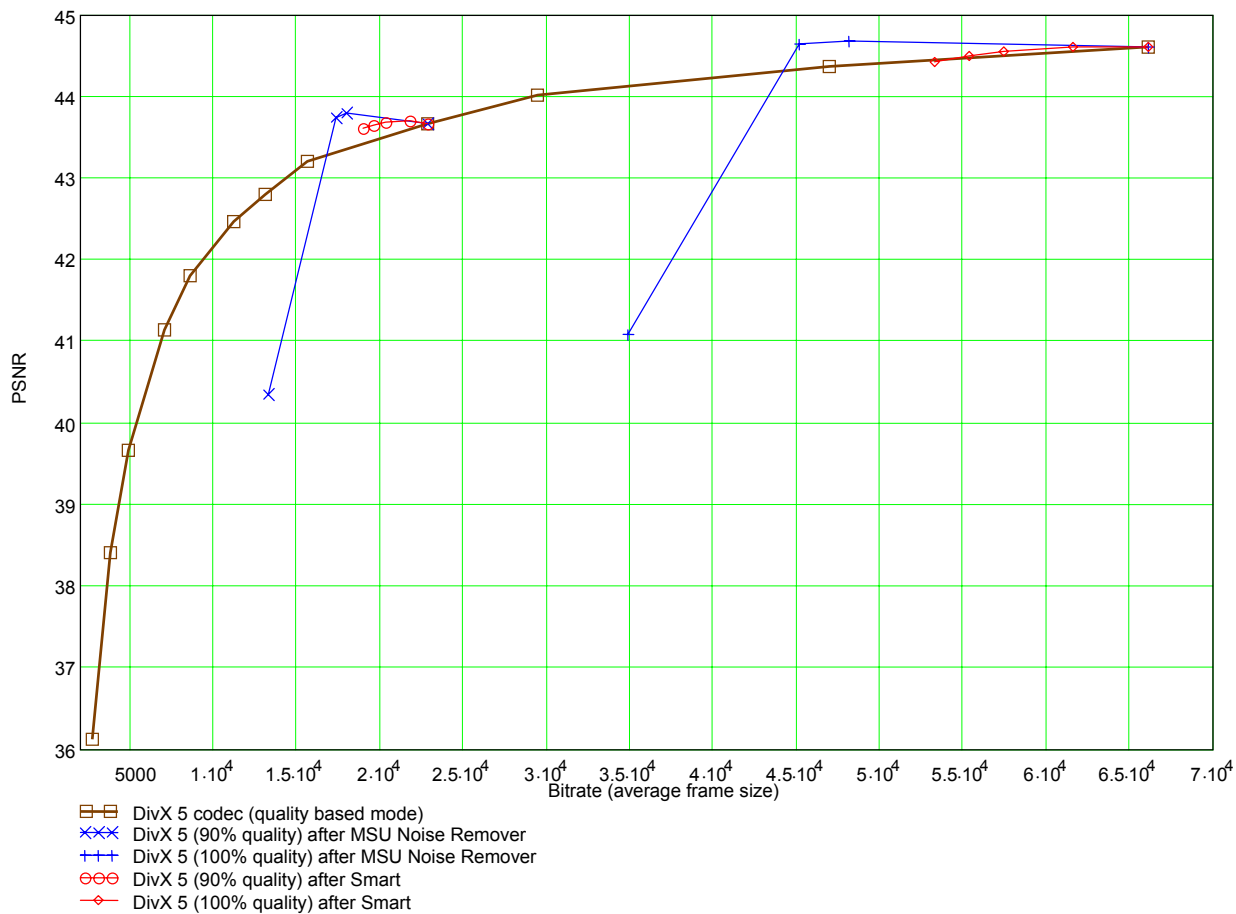
In this abstract there are given diagrams that show relation between PSNR metric and bitrate after using DivX codec with different values of quality. Also it is shown how this relation changes if a denoising filter is used before the compression. Denoising filters were applied before DivX with 90 and 100 percents quality settings.

Considered denoising filters are MSU Noise Remover and MSU Denoise by MSU Video Group and Smart Smoother1.1 by Donald Graft.

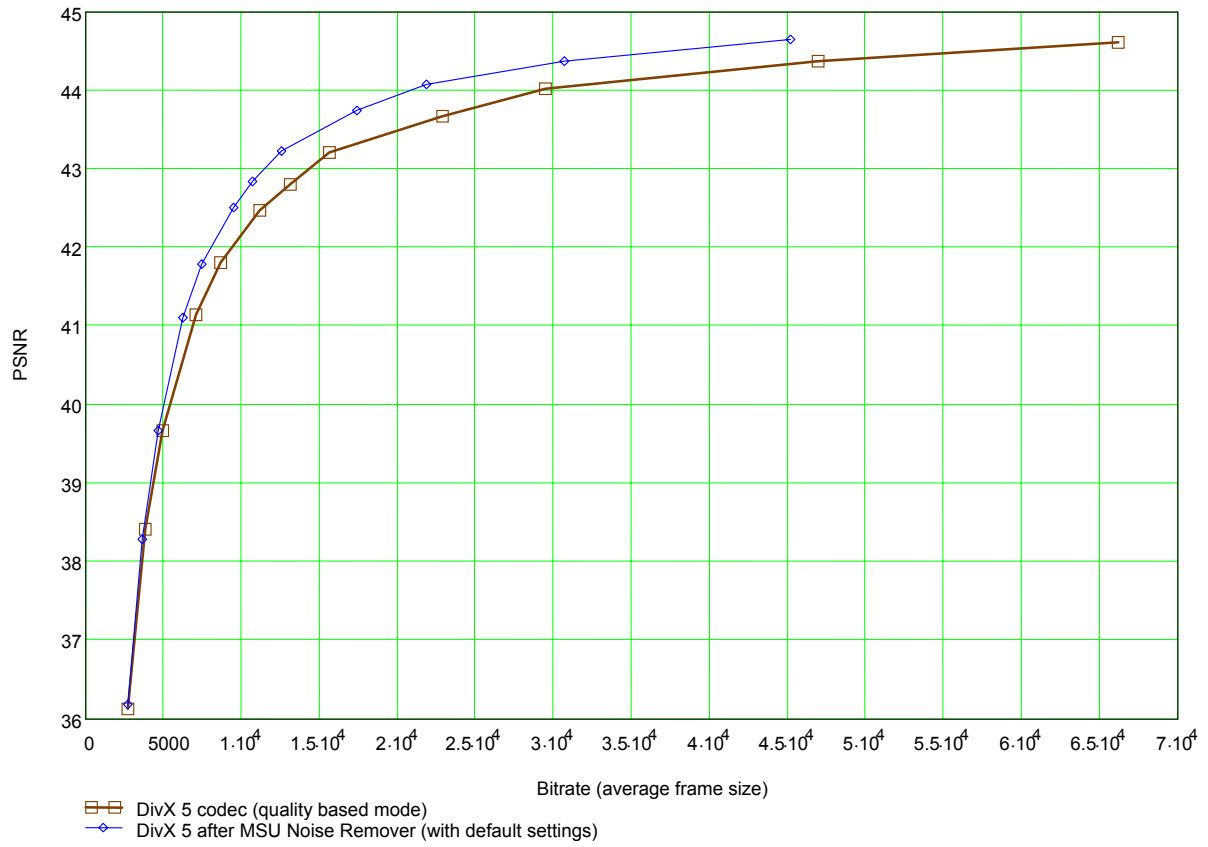
Three films were processed: news.avi, mother and daughter.avi, cact.avi.



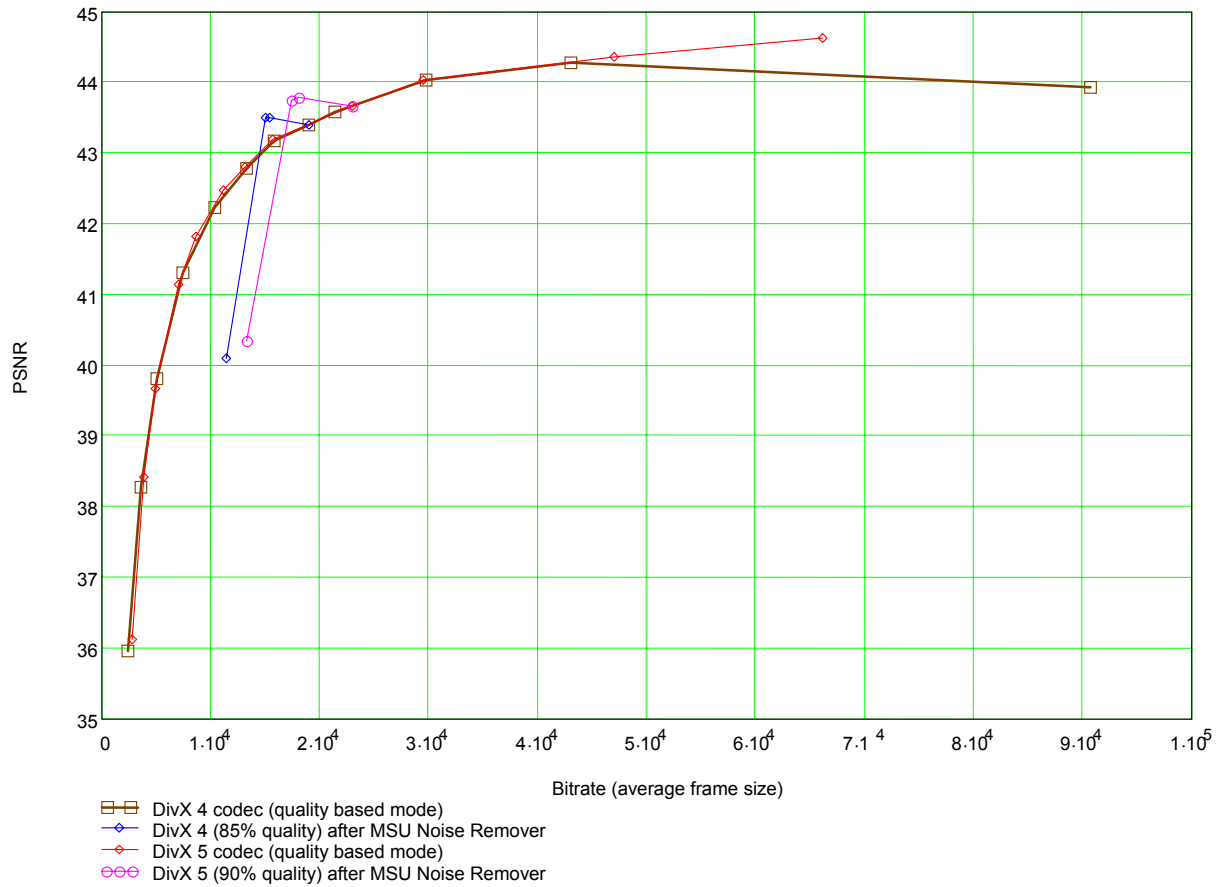
Picture 1. PSNR/Bitrate diagram for news.avi (MSU Noise Remover, MSU Denoiser, Smart)



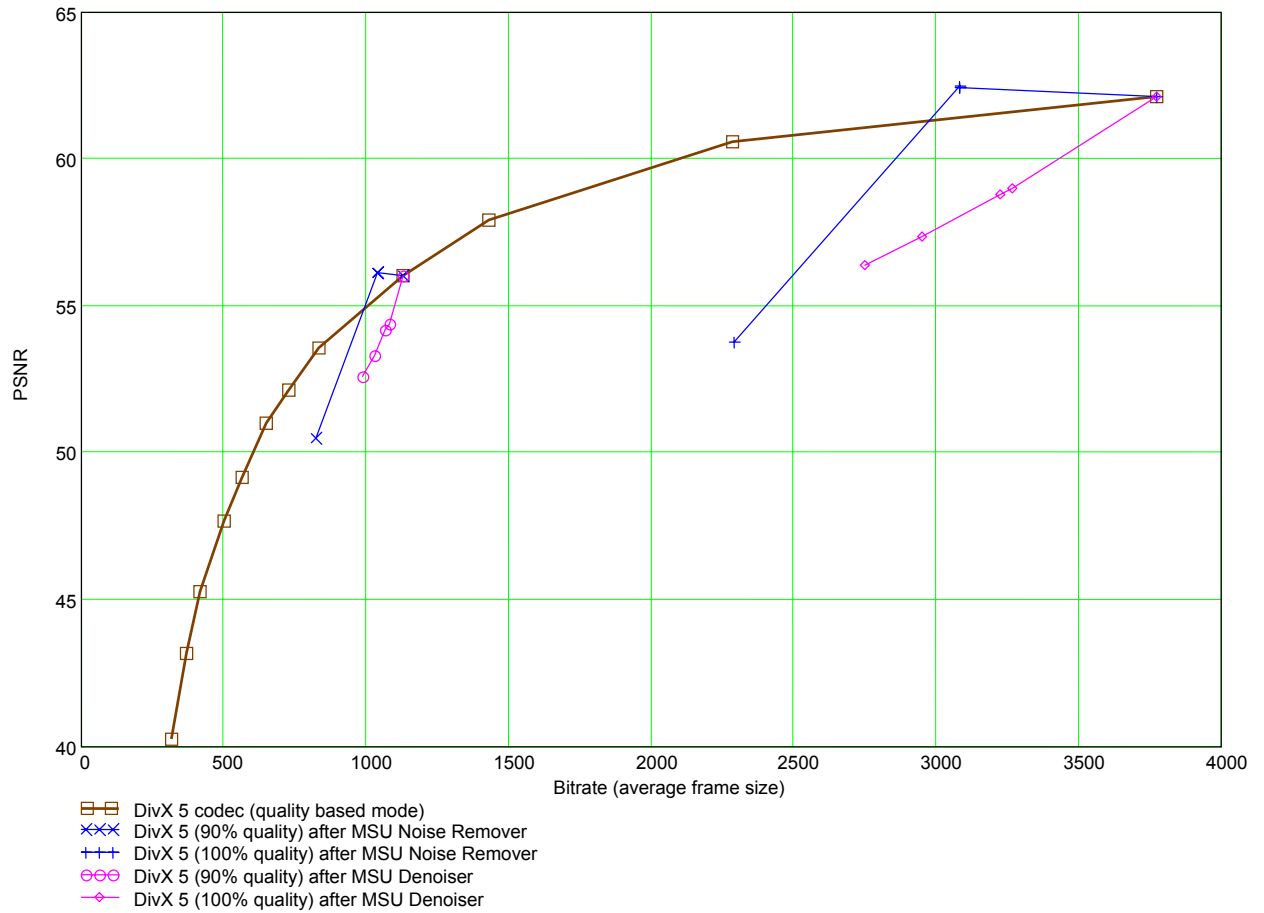
Picture 2. PSNR/Bitrate diagram for news.avi (MSU Noise Remover vs. Smart)



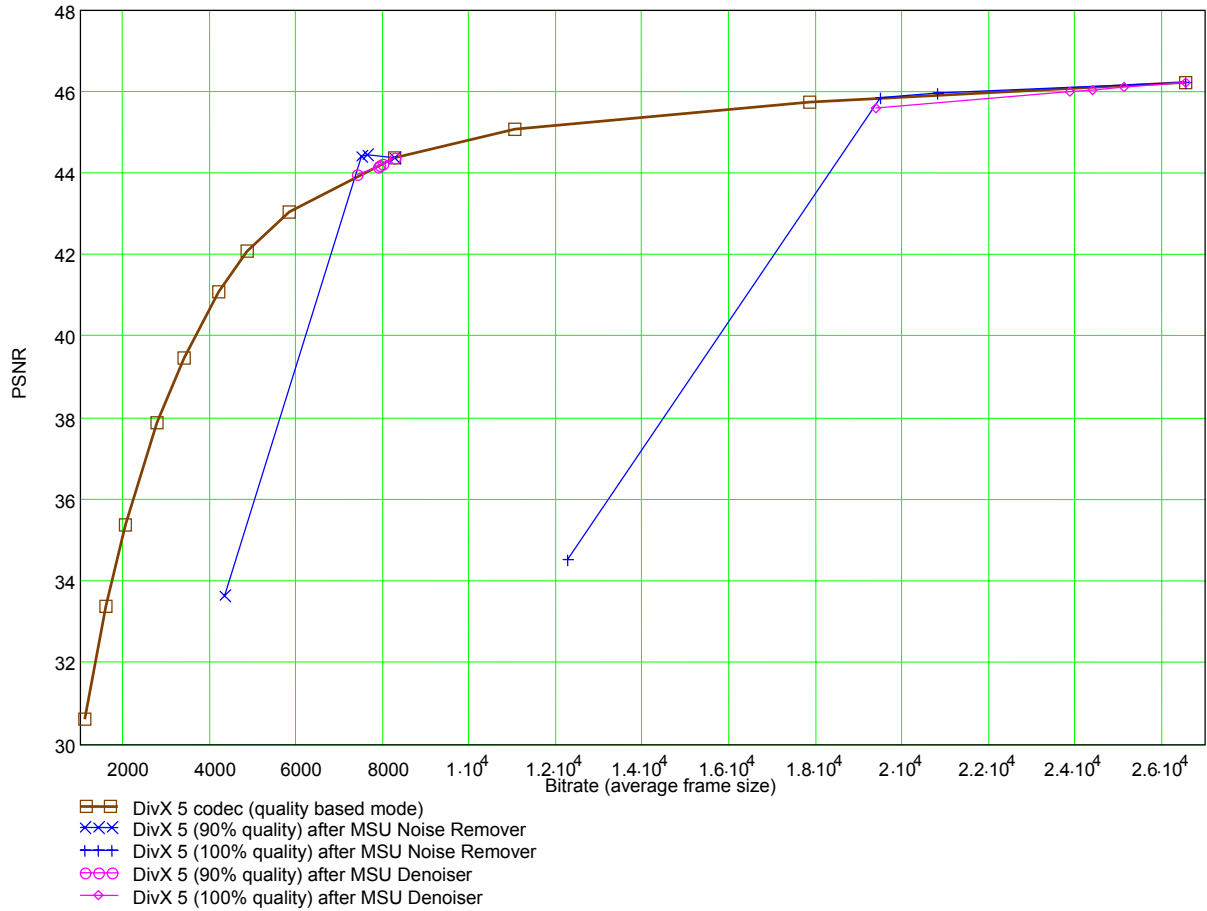
Picture 3. PSNR/Bitrate diagram for news.avi (MSU Noise Remover)



Picture 4. PSNR/Bitrate diagram for news.avi (MSU Noise Remover after DivX4 and DivX5)



Picture 5. PSNR/Bitrate diagram for mother and daughter.avi (MSU Noise Remover, MSU Denoiser)



Picture 6. PSNR/Bitrate diagram for cact.avi (MSU Noise Remover, MSU Denoiser)

Part 2: Visual comparison

The first column of the table shows the result after denoising filters` work. The second shows the same frame after DivX 5.0 (the quality option of DivX 5.0 is set to 100 %).

News, frame 15



Picture 7. Original



Picture 8. Original, DivX5.0



Picture 9. MSU Noise Remover



Picture 10. MSU Noise Remover, DivX5.0



Picture 11. MSU Denoiser



Picture 12. MSU Denoiser, DivX5.0



Picture 13. Original



Picture 14. Original, DivX5.0



Picture 15. MSU Noise Remover



Picture 16. MSU Noise Remover, DivX5.0



Picture 17. MSU Denoiser

Picture 18. MSU Denoiser, DivX5.0



Picture 19. Original



Picture 20. Original, DivX5.0



Picture 21. MSU Noise Remover



Picture 22. MSU Noise Remover, DivX5.0



Picture 23. MSU Denoiser



Picture 24. MSU Denoiser, DivX5.0

Comments: this film is characterized by high-level colored noise.

Mother and daughter, frame 145

Note: for clearness the contrast and the brightness of the images were increased.



Picture 25. Original



Picture 26. Original, DivX5.0



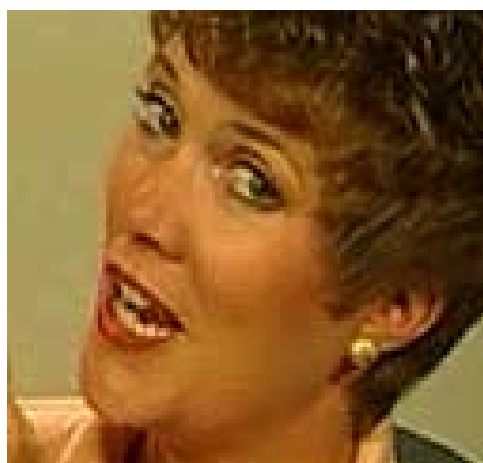
Picture 27. MSU Noise Remover



Picture 28. MSU Noise Remover, DivX5.0



Picture 29. MSU Denoiser



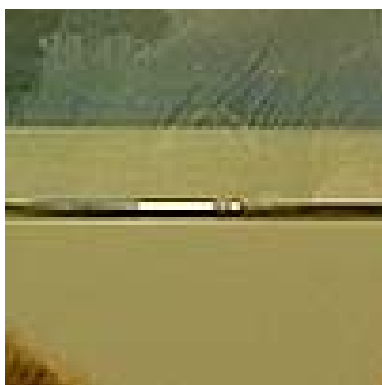
Picture 30. MSU Denoiser, DivX5.0



Picture 31. Original



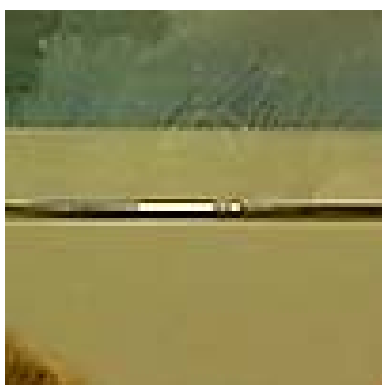
Picture 32. Original, DivX5.0



Picture 33. MSU Noise Remover



Picture 34. MSU Noise Remover, DivX5.0



Picture 35. MSU Denoiser



Picture 36. MSU Denoiser, DivX5.0



Picture 37. Original



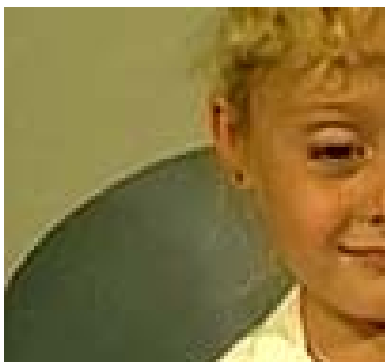
Picture 38. Original, DivX5.0



Picture 39. MSU Noise Remover



Picture 40. MSU Noise Remover, DivX5.0



Picture 41. MSU Denoiser



Picture 42. MSU Denoiser, DivX5.0

Comments: this film is characterized by low-level noise.

Cact, frame 125



Picture 43. Original



Picture 44. Original, DivX5.0



Picture 45. MSU Noise Remover



Picture 46. MSU Noise Remover, DivX5.0



Picture 47. MSU Denoiser



Picture 48. MSU Denoiser, DivX5.0



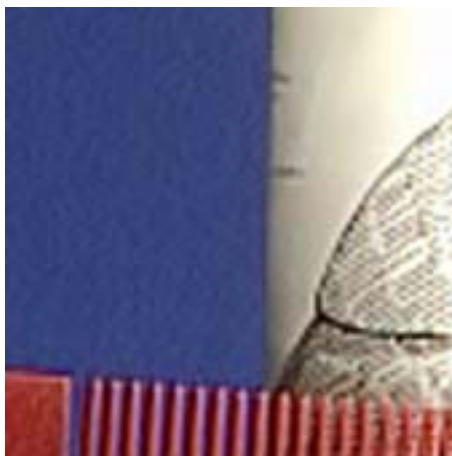
Picture 49. Original, DivX5.0 (quality = 90%)



Picture 50. MSU Noise Remover, DivX5.0 (quality = 90%)



Picture 51. Original



Picture 52. Original, DivX5.0



Picture 53. MSU Noise Remover



Picture 54. MSU Noise Remover, DivX5.0



Picture 55. MSU Denoiser



Picture 56. MSU Denoiser, DivX5.0



Picture 57. Original, DivX5.0
(quality = 90%)



Picture 58. MSU Noise Remover, DivX5.0
(quality = 90%)



Picture 59. Original



Picture 60. Original, DivX5.0



Picture 61. MSU Noise Remover



Picture 62. MSU Noise Remover, DivX5.0



Picture 63. MSU Denoiser



Picture 64. MSU Denoiser, DivX5.0



Picture 65. Original, DivX5.0 (quality = 90%)



Picture 66. MSU Noise Remover, DivX5.0 (quality = 90%)

Comments: this film is characterized by high-level noise.

Picture 67. Msu7.avi original

Picture 68. Msu7.avi original (residual)

Part 4: Comments

Both MSU Noise Remover can automatically adapt to the level of noise. MSU Noise Remover detects the level of noise in both spatial and temporal spaces. It works at 0.4 fps speed.

MSU Denoiser has presets for different levels of noise. It works at 17 fps speed.