MSU Denoising & Noise Remover Filters

10 March 2004

Prepared by Dasha Kalinkina
Sc. head: Dmitriy Vatolin
For contacts: video@graphics.cs.msu.su

Contents

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

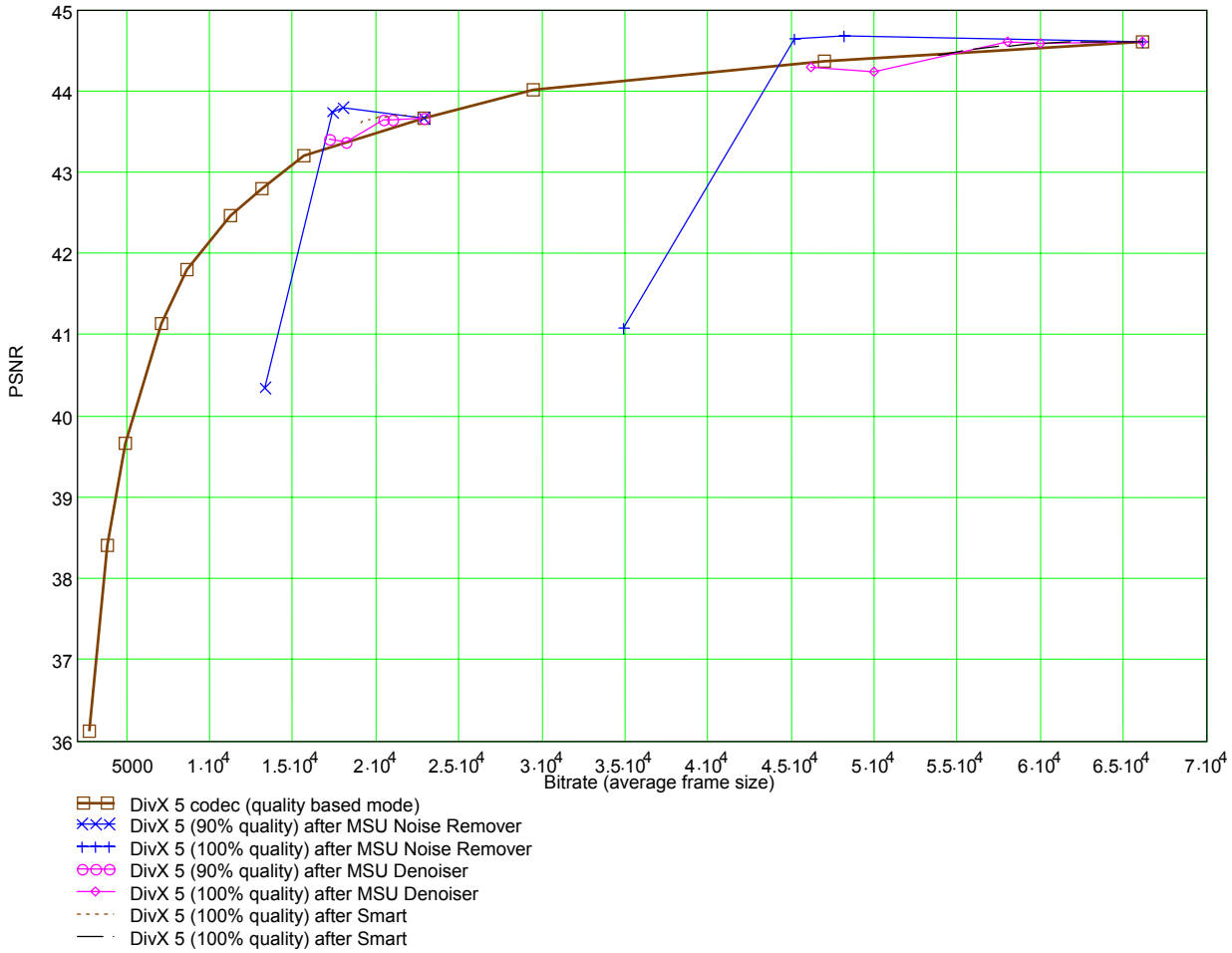
Up to 30% bigger compression with the same PSNR and better visual quality.

Part1: Denoising Filters with DivX

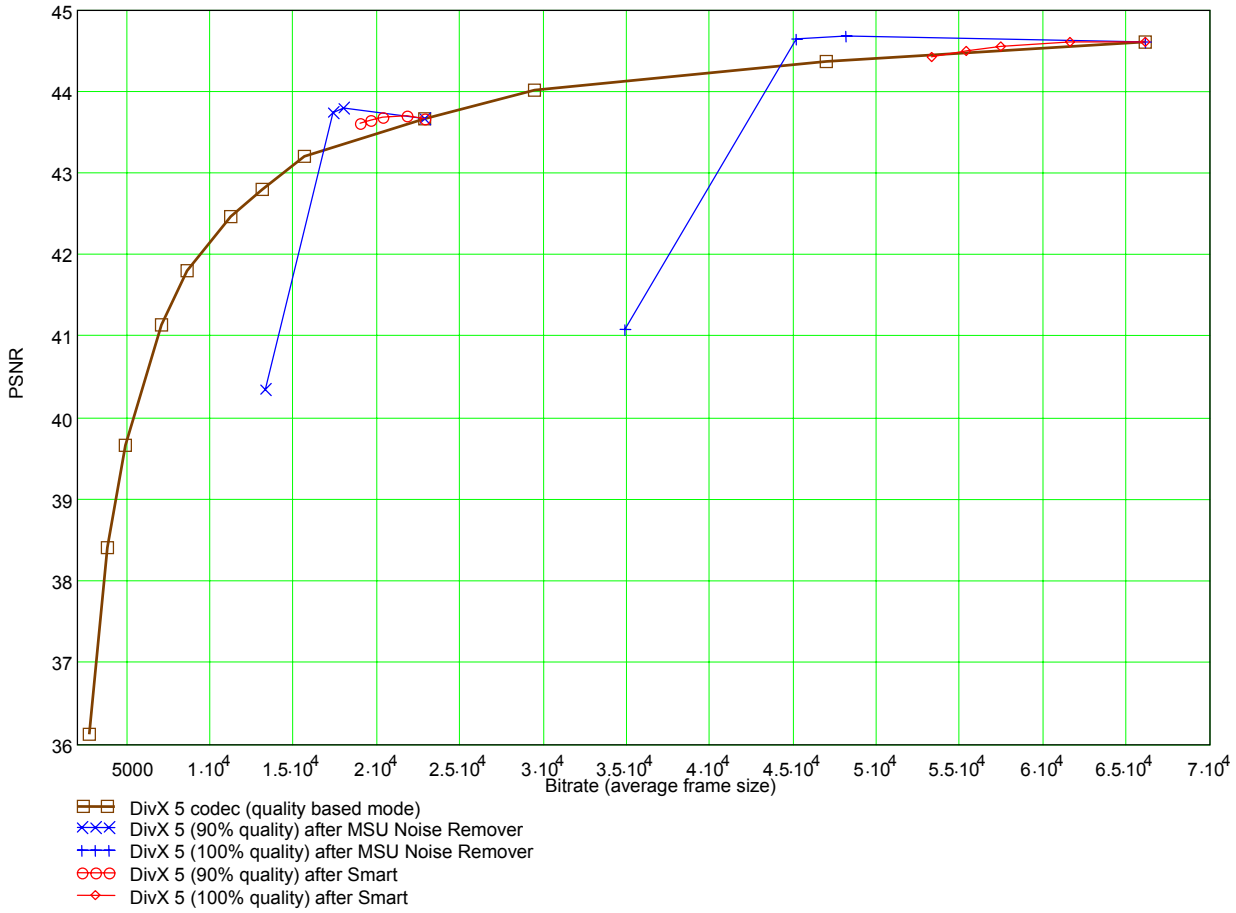
In this abstract there are given diagrams that show relation between PSNR metric and bitrate after using DivX codec with different values of quality. Also it is shown how this relation changes if a denoising filter is used before the compression. Denoising filters were applied before DivX with 90 and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

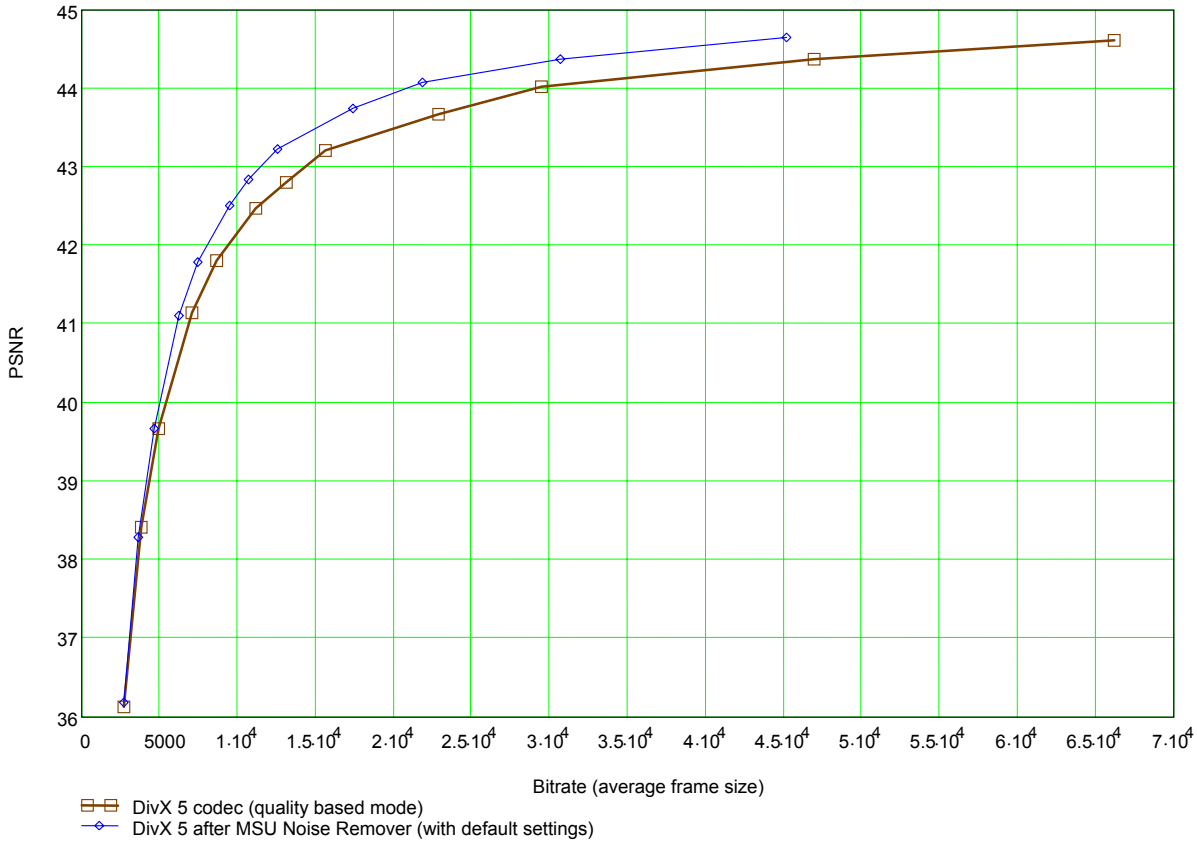
Three films were processed: news.avi, mother and daughter.avi, cact.avi.



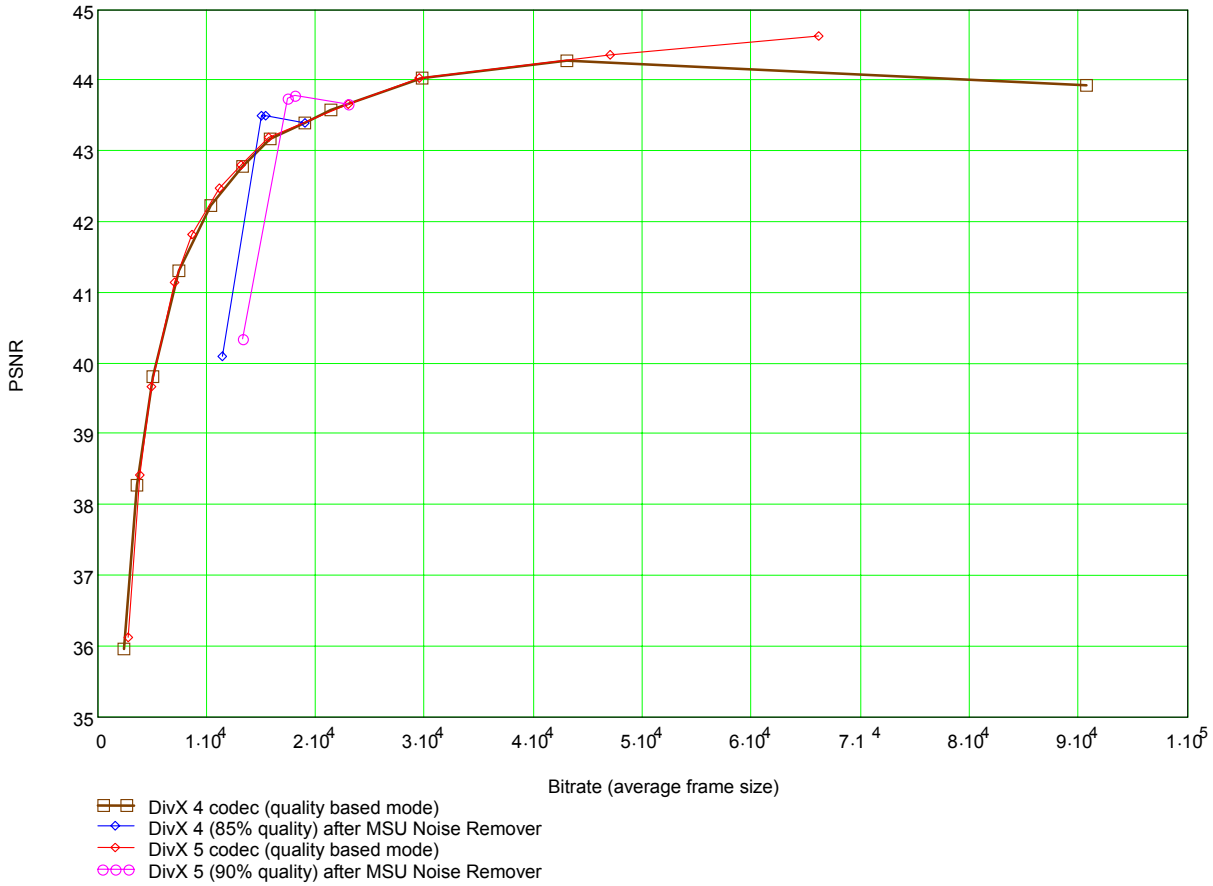
Picture 1. PSNR/Bitrate diagram for news.avi (MSU Noise Remover, MSU Denoiser, Smart)



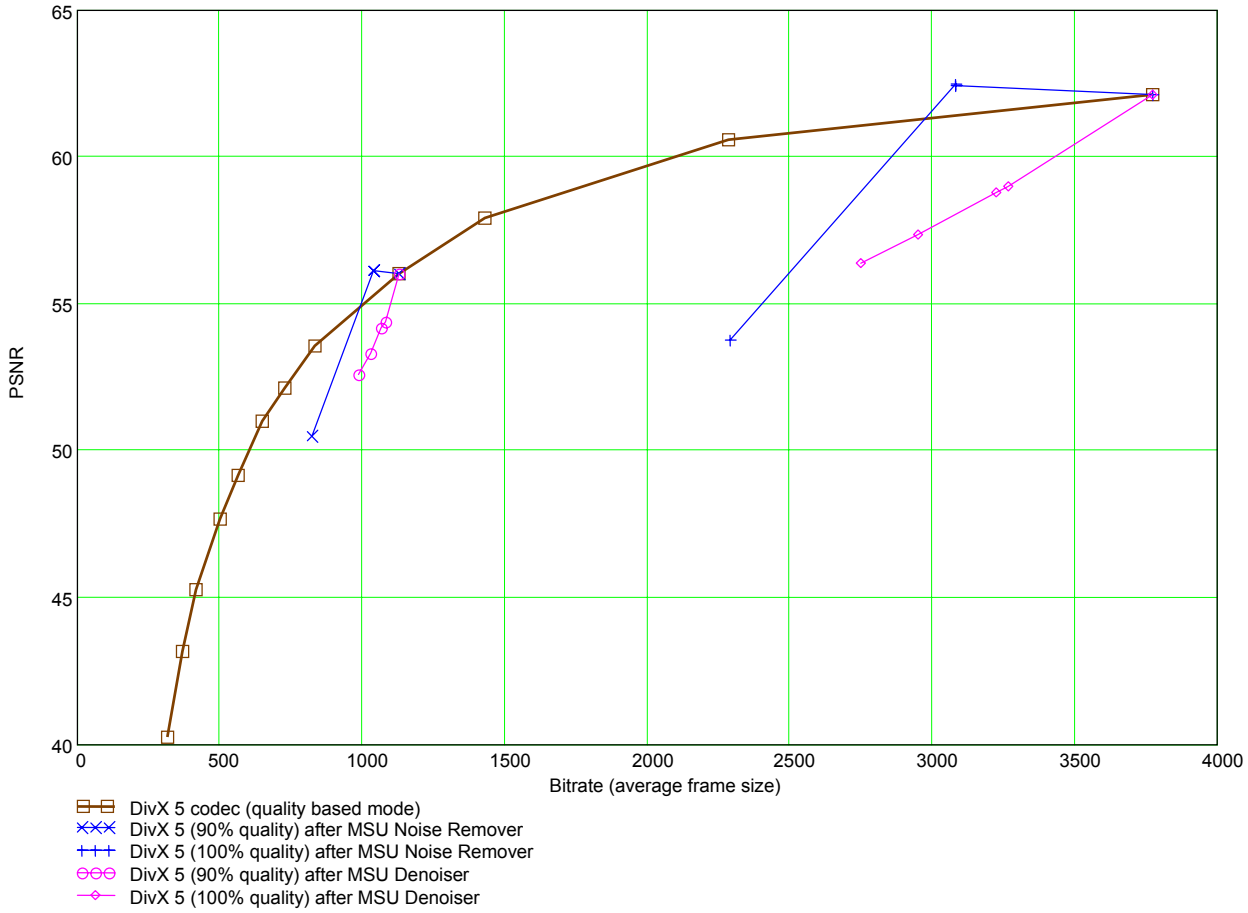
Picture 2. PSNR/Bitrate diagram for news.avi (MSU Noise Remover vs. Smart)



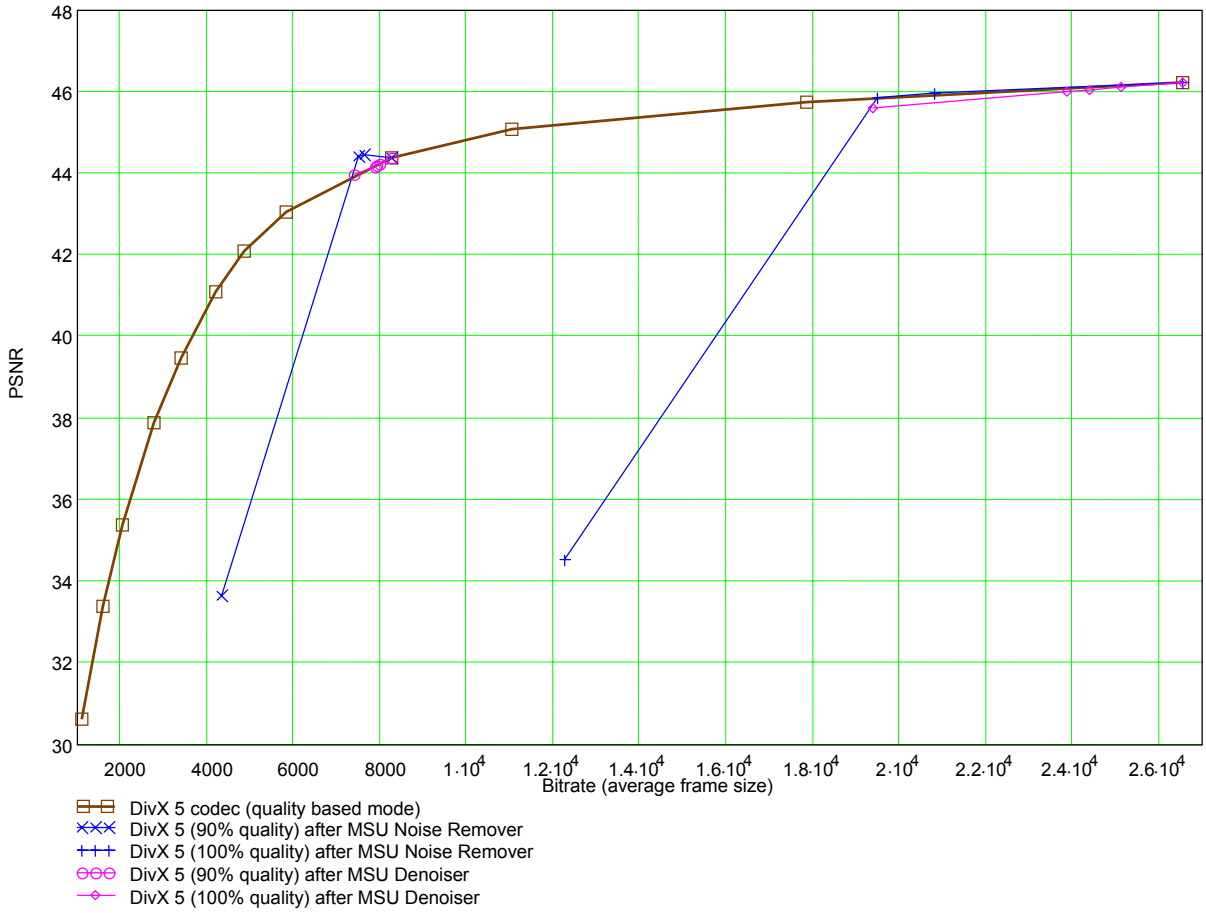
Picture 3. PSNR/Bitrate diagram for news.avi (MSU Noise Remover)



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.