



Compressione di immagini tramite autoencoder

stato dell'arte e sviluppi futuri

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Compressione



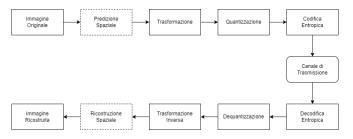


Figure: Blocchi funzionali principali di un framework lossy¹, con l'aggiunta di un quarto blocco per i metodi recenti

¹H. T. Sadeeq, T. H. Hameed, A. S. Abdi, et al., "Image compression using neural networks: A review," International Journal of Online and Biomedical Engineering (IJOE), vol. 17, no. 14, pp. 135–153, 2021

Metodi Tradizionali



I metodi di codifica tradizionale analizzati in questo studio sono i seguenti

- JPEG¹
- JPEG2000²
- BPG³
- VVC⁴

¹G. Wallace, "The jpeg still picture compression standard," *IEEE Transactions on Consumer Electronics*, vol. 38, no. 1, pp. xviii→xxiv, 1992, poi; 10.1109/30.125072

²A. Skodras, C. Christopoulos, and T. Ebrahimi, "The jpeg 2000 still image compression standard," *IEEE Signal Processing Magazine*, vol. 18, no. 5, pp. 36–58, 2001. DOI: 10.1109/79.952804

³F. Bellard, Bpg image format, https://bellard.org/bpg/, Consultato: 17-10-2023

⁴B. Bross, Y.-K. Wang, Y. Ye, et al., "Overview of the versatile video coding (vvc) standard and its applications," IEEE Transactions on Circuits and Systems for Video Technology, vol. 31, no. 10, pp. 3736–3764, 2021. DOI: 10.1109/TCSVT.2021.3101953

Autoencoder



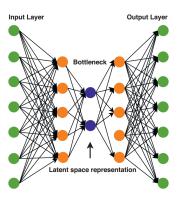


Figure: Schema generico di un autoencoder, immagine presa dal documento *Deep architectures for image compression: A critical review*¹

¹D. Mishra, S. K. Singh, and R. K. Singh, "Deep architectures for image compression: A critical review," *Signal Processing*, vol. 191, p. 108 346, 2022

Metodi con reti neurali



I metodi di codifica con itelligenza artificiale analizzati in questo studio sono i seguenti

- Variational compression with a scale hyperprior, Ballé et al¹.
- Discretized gaussian mixture likelihoods, Cheng et al².
- Neural data-dependent transform, Wang et al³.

¹D. Minnen, J. Ballé, and G. D. Toderici, "Joint autoregressive and hierarchical priors for learned image compression." *Advances in neural information processing systems*, vol. 31, 2018

²Z. Cheng, H. Sun, M. Takeuchi, et al., "Learned image compression with discretized gaussian mixture likelihoods and attention modules," in *Proceedings of the IEEE/CVF conference on computer vision and pattern recognition*, 2020, pp. 7939–7948

³D. Wang, W. Yang, Y. Hu, et al., "Neural data-dependent transform for learned image compression," in Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition, 2022, pp. 17379–17388

Ballé et al¹. 2018



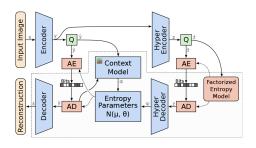


Figure: Diagramma rete Ballé 2018 et al., immagine presa dal documento int autoregressive and hierarchical priors for learned image compression¹

¹D. Minnen, J. Ballé, and G. D. Toderici, "Joint autoregressive and hierarchical priors for learned image compression." *Advances in neural information processing systems*, vol. 31, 2018

Cheng et al¹. 2020



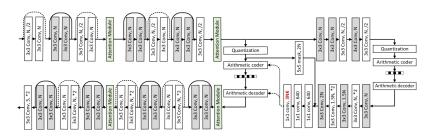


Figure: Diagramma rete Cheng 2020 et al., immagine presa dal documento earned image compression with discretized gaussian mixture likelihoods and attention modules¹

¹Z. Cheng, H. Sun, M. Takeuchi, et al., "Learned image compression with discretized gaussian mixture likelihoods and attention modules," in *Proceedings of the IEEE/CVF conference on computer vision and pattern recognition*, 2020, pp. 7939–7948

Wang et al¹. 2022



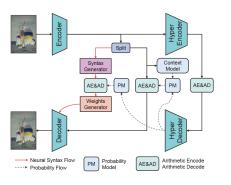


Figure: Diagramma rete Wang 2022 et al., immagine presa dal documento Neural data-dependent transform for learned image compression¹

¹D. Wang, W. Yang, Y. Hu, et al., "Neural data-dependent transform for learned image compression," in Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition, 2022, pp. 17379–17388

Esempi Compressione



Esempi di compressione di un immagine del dataset Kodak¹ con le tecniche presentate















Figure: Figure: Lossless JPFG

Figure: Figure: JPFG2000BPG 11.117bpp0.167bpp 0.137bpp 0.103bpp 0.061bpp

Figure: VVC.

Figure: Ballé 0.060bpp

Figure: Cheng 0.056bpp

¹E. K. Company, True color kodak images, https://r0k.us/graphics/kodak/, Consultato: 17-10-2023

Tempi di Compressione



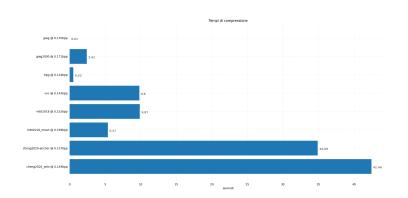


Figure: Tempi di compressione a 0.16 bpp

Tempi di Compressione



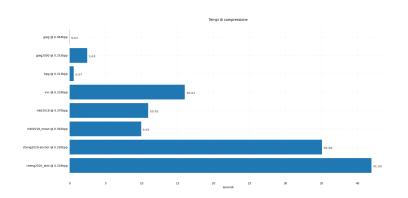


Figure: Tempi di compressione a 0.34 bpp

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PSNR



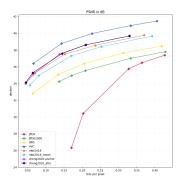


Figure: Grafico del PSNR, punti corrispondenti alla media delle metriche sulle 24 immaigni del dataset

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MS-SSIM



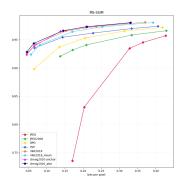


Figure: Grafico dell'MS-SSIM¹, punti corrispondenti alla media delle metriche sulle 24 immaigni del dataset

¹Z. Wang, E. P. Simoncelli, and A. C. Bovik, "Multiscale structural similarity for image quality assessment," in *The Thrity-Seventh Asilomar Conference on Signals, Systems & Computers*, 2003, Ieee, vol. 2, 2003, pp. 1398–1402

LPIPS con AlexNet



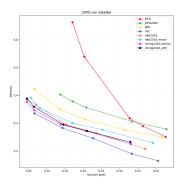


Figure: Grafico LPIPS¹ con AlexNet, punti corrispondenti alla media delle metriche sulle 24 immaigni del dataset

¹R. Zhang, P. Isola, A. A. Efros, et al., "The unreasonable effectiveness of deep features as a perceptual metric," in *Proceedings of the IEEE conference on computer vision and pattern recognition*, 2018, pp. 586–595

Sviluppi Futuri



Durante la ricerca delle informazioni per la stesura di questa tesi ci siamo imbattuti in due lavori molto interessanti

- StructuralADAM¹
- SmallCAE²

¹ J. Ballé, "Efficient nonlinear transforms for lossy image compression," in 2018 Picture Coding Symposium (PCS), IEEE, 2018, pp. 248–252

¹F. Yang, L. Herranz, Y. Cheng, et al., "Slimmable compressive autoencoders for practical neural image compression," in *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition*, 2021, pp. 4998–5007



Grazie per la vostra attenzione