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Optimizing Super Resolution Generative Adversarial Networks for Resource-Efficient Single-Image Super-Resolution via Knowledge Distillation and Weight Pruning

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Abstract : Image super-resolution is the most common computer vision problem with many important applications. Generative adversarial networks (GANs) have promoted remarkable advances in single-image super-resolution (SR) by recovering photo-realistic images. However, high memory requirements of GAN-based SR (mainly generators) lead to performance degradation and increased energy consumption, making it difficult to implement it onto resource-constricted devices. To relieve such a problem, In this paper, we introduce an optimized and highly efficient architecture for SR-GAN (generator) model by utilizing model compression techniques such as Knowledge Distillation and pruning, which work together to reduce the storage requirement of the model also increase in their performance. Our method begins with distilling the knowledge from a large pre-trained model to a lightweight model using different loss functions. Then, iterative weight pruning is applied to the distilled model to remove less significant weights based on their magnitude, resulting in a sparser network. Knowledge Distillation reduces the model size by 40%; pruning then reduces it further by 18%. To accelerate the learning process, we employ the Horovod framework for distributed training on a cluster of 2 nodes, each with 8 GPUs, resulting in improved training performance and faster convergence. Experimental results on various benchmarks demonstrate that the proposed compressed model significantly outperforms state-of-the-art methods in terms of peak signal-to-noise ratio (PSNR), structural similarity index measure (SSIM), and image quality for x4 super-resolution tasks.

Keywords : single-image super-resolution, generative adversarial networks, knowledge distillation, pruning
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