氏　　名	VIRIYAVISUTHISAKUL Supatta		
学位の種類	博士（情報科学）		
学位記番号	博情第 513 号		
学位授与年月日	令和 5 年 9 月 22 日		
論文題目	Parametric Loss Based Super-Resolution for Scene Text Recognition		
論文審査委員	Nguyen Le Minh	JAIST	Professor
	Shinobu Hasegawa	JAIST	Professor
	Kiyoaki Shirai	JAIST	Assoc. Prof.
	Shogo Okada	JAIST	Assoc.Prof
	KAOTHANTHONG Natsuda		
	Thammasat University.	Assistant. Prof	
	Toshihiko Yamasaki	Tokyo University	Professor
	Satoshi Tojo	Asia University	Professor

論文の内容の要旨

In this study, we propose the application of multiple parametric regularizations and parametric weight parameters to the loss function of the scene text image super-resolution (STISR) method to improve scene text image quality and text recognition accuracy. STISR is regarded as the process of improving the image quality of low-resolution (LR) scene text images to improve text recognition accuracy. In a previous study, a text attention network (TATT) was introduced to reconstruct high-resolution scene text images; the backbone method involved the convolutional neural network (CNN)-based and transformer-based architecture. Although it can deal with rotated and curved-shaped texts, it still cannot properly handle images containing improper-shaped texts and blurred text regions. This can lead to incorrect text predictions during the text recognition step. Parametric regularization in the single-image super-resolution (SISR) model has recently been proposed to deal with artifacts and restore the unseen texture in the natural image domain. However, unlike STISR, SISR does not focus only on text information. Here, we design and extend it into three types of methods: adding multiple parametric regularizations, modifying parametric weight parameters, and combining parametric weights and multiple parametric regularizations. Experiments were conducted and compared with state-of-the-art of STISR models. The results showed a significant improvement for every proposed method. Our methods achieved the best text recognition accuracy of 80.4% for the easy set, 64.1% for the medium set, and 46.5% for the hard set of Textzoom. Moreover, our methods generated clearer and sharper edges than the baseline with a better-quality image score.

Keywords: Scene Text, Image Reconstruction, Trainable parameter, Parametric, Regularization,
Loss function

論文審査の結果の要旨

This thesis presents a study on scene text image super-resolution, which involves the task of reconstructing a high-resolution image to improve the accuracy of text recognition in a low-resolution image. The thesis introduces Parametric Weights for adjustable weight parameters of loss functions. Additionally, it presents a Multiple Parametric Regularization approach by incorporating multiple regularization terms into the loss functions in deep learning models including (CNN, GAN, transformer-based SR, STIRS). These techniques aim to enhance learning performance and prediction accuracy with regularization terms. Both methodologies are integrated into the state-of-the-art model known TATT for Text Image Super-resolution. Empirical results demonstrate that the proposed methods effectively enhance the quality of low-resolution scene text images, providing clear and easily recognizable text information for human perception. More specifically, the main contributions of this study are:

- The candidate propose a novel adaptive framework for the loss function of STISR models that all parameters in the framework can be learnable.
- The candidate propose three methods in the loss function of studied models: (1) Multiple Parametric Recognition (MPR), (2) Parametric Weights (PW), (3) Parametric Weights and Multiple Parametric Recognition (PW+MPR).
- The proposed method can improve the text recognition accuracy, visual com- parison, and image quality assessment (IQA) than the state-of-the-art models.

The candidate has published two journal papers and numerous international and domestic conference papers which show good contribution of the candidate.

Overall, this is an excellent dissertation, and we approve of awarding a doctoral degree to VIRIYAVISUTHISAKUL Supatta.