

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

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| To: KIM, Tae-hun 9th Floor, Shinduk Bldg., 343, Gangnam-daero Seocho-gu Seoul 06626 Republic of Korea | | Date of mailing (day/month/year) 11 August 2020 (11.08.2020) | |
| Applicant's or agent's file reference OEC12457PCT | | FOR FURTHER ACTION See paragraph 2 below | |
| International application No. PCT/KR2020/005432 | International filing date (day/month/year) 24 April 2020 (24.04.2020) | Priority date(day/month/year) 16 May 2019 (16.05.2019) | |
| International Patent Classification (IPC) or both national classification and IPC G06N 3/08(2006.01)i, G06N 20/10(2019.01)i, H04N 5/21(2006.01)i | | | |
| Applicant SAMSUNG ELECTRONICS CO., LTD. | | | |

1. This opinion contains indications relating to the following items:

- Box No. I Basis of the opinion
- Box No. II Priority
- Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- Box No. IV Lack of unity of invention
- Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- Box No. VI Certain documents cited
- Box No. VII Certain defects in the international application
- Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

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|---|---|---|
| Name and mailing address of the ISA/KR International Application Division Korean Intellectual Property Office 189 Cheongsu-ro, Seo-gu, Daejeon, 35208, Republic of Korea Facsimile No. +82-42-481-8578 | Date of completion of this opinion 11 August 2020 (11.08.2020) | Authorized officer YANG JEONG ROK Telephone No. +82-42-481-5709 |
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WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/KR2020/005432

Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of :
 - the international application in the language in which it was filed
 - a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))
2. This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(b))
3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:
 - a. forming part of the international application as filed:
 - in the form of an Annex C/ST.25 text file.
 - on paper or in the form of an image file.
 - b. furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.
 - c. furnished subsequent to the international filing date for the purposes of international search only:
 - in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).
 - on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).
4. In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
5. Additional comments:

Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

| | | | |
|-------------------------------|--------|-------------|-----|
| Novelty (N) | Claims | <u>1-15</u> | YES |
| | Claims | <u>NONE</u> | NO |
| Inventive step (IS) | Claims | <u>NONE</u> | YES |
| | Claims | <u>1-15</u> | NO |
| Industrial applicability (IA) | Claims | <u>1-15</u> | YES |
| | Claims | <u>NONE</u> | NO |

2. Citations and explanations :

Reference is made to the following documents:

D1: JIAHUI YU et al., 'Wide Activation for Efficient and Accurate Image Super-Resolution', arXiv:1808.08718v2, 21 December 2018, pp. 1-10

D2: RUSSELL HARDIE, 'A Fast Image Super-Resolution Algorithm Using an Adaptive Wiener Filter', IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 16, NO. 12, December 2007, pp. 2953-2964

I. Novelty and Inventive Step (PCT Article 33(2) and 33(3))

1. Claims 1, 11

D1, which is considered to be the closest prior art to the subject matter of claim 1, discloses a system for single image super-resolution (SISR), comprising:

a means for generating low-level SR features to propagate to a final layer for better dense pixel value predictions by using shallow layers of shallow convolutional neural networks (see pages 1-2; and figure 1);

a means for applying one 1x1 convolution (a pointwise convolution) to reduce number of channels on the low-level SR features, and outputting first data (see pages 4-5; and figure 1);

a means for applying one 3x3 convolution (depthwise convolution) on the first data to perform spatial-wise feature extraction (see pages 4-5; and figure 1); and

a means for performing weight normalization for training deep SR network (see page 2).

Claim 1 differs from D1 in adjusting first values of first weights based on first positions of the first weights; and adjusting second values of second weights based on second positions of the second weights.

However, the different feature would be easily derived from the disclosure of D2 (see page 2954: "Another novel aspect of this work is that we apply a spatially varying statistical model

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**WRITTEN OPINION OF THE
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International application No.
PCT/KR2020/005432

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

Claims 7 and 8 do not comply with PCT Rule 6.1(a) since they are identical.

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of : Box No. V

in the spirit of [21, 22] to control the SR filter weights. Thus, the filter weights adapt spatially and temporally to changing spatial distributions of LR pixels on the HR grid, and to the local intensity statistics of those LR pixels.").

It would have been obvious to a person skilled in the art to arrive at the matter defined in claim 1 by combining the teachings of D1 and D2.

Claim 11 relates to a method. Since the technical features of claim 11 are substantially the same as those of claim 1 except for the category of invention, the same reasoning as in claim 1 applies to claim 11.

Therefore, claims 1, 11 lack an inventive step.

2. Claims 2-10, 12-15

The additional features of claims 2, 12 are merely variations of the disclosure of D1 (see pages 4-5; and figure 1: applying the pointwise convolution; and see page 2: performing the weight normalization) and the disclosure of D2 (see page 2954: "Thus, the filter weights adapt spatially and temporally to changing spatial distributions of LR pixels on the HR grid, and to the local intensity statistics of those LR pixels.").

The additional features of claims 3, 13 would be easily derived from the disclosure D2 (see page 2956; "Note that before applying the weights in (7), each column in W_i is normalized so that it sums up to 1 to ensure continuity across observation windows and to avoid potential grid pattern artifacts.").

The additional features of claims 4-5, 14-15 are merely variations of the disclosure of D2 (see page 2954: "The weights for each HR pixel are designed to minimize mean squared error based on the relative spatial locations of the LR pixels.").

The additional feature of claim 6 is merely a variation of the disclosure of D1 (see pages 4-5; and figure 1: applying the depthwise convolution) and the disclosure of D2 (see page 2954: "This is because the spatial location of the LR pixel around each HR pixel is considered individually, allowing the filter weights to be optimized for each HR pixel independently.").

The additional features of claims 7-8 are merely variations of the disclosure of D2 (see page 2956: "This allows the filter to adapt to any changing intensity statistics and varying spatial distributions of the LR pixels on the HR grid. The observation window moves across the HR grid in steps of D_x and D_y in the horizontal and vertical directions, respectively.").

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The additional features of claims 9-10 would be easily derived from the disclosure of D1 (page 1: "SISR aims at recovery of a high resolution (HR) image from its low resolution (LR) counterpart (typically a bicubic downsampled version of HR).").

Accordingly, claims 2-10, 12-15 would have been obvious over D1 in view of D2. Therefore, claims 2-10, 12-15 lack an inventive step.

II. Industrial Applicability (PCT Article 33(4))

Claims 1-15 are industrially applicable.