Enhanced Spectrum Sensing Techniques for 5G New Radio (NR) and Long-Term Evolution (LTE) Utilizing Unet++ Deep Learning Network

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***Abstract*—The 5G New Radio (NR) technology emerged in several recent years that is the latest generation in wireless communication technology. The 5G New Radio offers significantly higher peak data range, high-frequency, and low-latency comparing to Long-Term Evolution (LTE). Both of them can be distinguished by the frequency range of spectrum extraction. In the recent year, the deep learning network domain introduced various cutting-edge approaches to tackle image processing in several application such as medical identify, spectrum sensing in signal processing, and automotive industry that utilize image segmentation techniques. In this paper, we propose the cutting-edge deep learning network base on Unet++ to enhance spectrum sensing for 5G New Radio (NR) and Long-Term Evolution (LTE) that incorporated by Unet++ and attention gate. In detail, we replaced traditional convolution by group convolution to reduce dramatically parameters of own network, around 50 percentage comparing with original Unet++ network, attention gates are applied into each skip connection to focus on the essential segmentation region in the small image. We utilize the spectrum of 5GNR and LTE dataset which were generated by MatLab 5G toolbox to evaluate own network, compare with other DeepLabv3++ and original Unet models. The accuracy of own network reached XXX percentage that is higher than DeepLabv3++, Unet, Unet++ by xx, yy, zz percentage. Our implementation and pre-trained model are available at: Spectrum sensing base on deep learning Github project**

***Index Terms*—Neuronal Structure Segmentation, Semantic Segmentation, , Deep Supervision, Model Pruning, spectrum sensing,**

I. Introduction

II. Ease of Use

A. Maintaining the Integrity of the Specifications

The IEEEtran class file is used to format your paper and style the text. All margins, column widths, line spaces, and text fonts are prescribed; please do not alter them. You may note peculiarities. For example, the head margin measures proportionately more than is customary. This measurement and others are deliberate, using specifications that anticipate your paper as one part of the entire proceedings, and not as an independent document. Please do not revise any of the current designations.

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Before you begin to format your paper, first write and save the content as a separate text file. Complete all content and organizational editing before formatting. Please note sections **??–??** below for more information on proofreading, spelling and grammar.

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Number equations consecutively. To make your equations more compact, you may use the solidus (/), the exp function, or appropriate exponents. Italicize Roman symbols

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$$a + b = \gamma \tag{1}$$

Be sure that the symbols in your equation have been defined before or immediately following the equation. Use "(**??**)", not "Eq. (**??**)" or "equation (**??**)", except at the beginning of a sentence: "Equation (**??**) is . . ."

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E. Some Common Mistakes

- The word "data" is plural, not singular.
- The subscript for the permeability of vacuum μ_0, and other common scientific constants, is zero with subscript formatting, not a lowercase letter "o".
- In American English, commas, semicolons, periods, question and exclamation marks are located within quotation marks only when a complete thought or name is cited, such as a title or full quotation. When quotation marks are used, instead of a bold or italic typeface, to highlight a word or phrase, punctuation should appear outside of the quotation marks. A parenthetical phrase or statement at the end of a sentence is punctuated outside of the closing parenthesis (like this). (A parenthetical sentence is punctuated within the parentheses.)
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An excellent style manual for science writers is [**?**].

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Headings, or heads, are organizational devices that guide the reader through your paper. There are two types: component heads and text heads.

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Text heads organize the topics on a relational, hierarchical basis. For example, the paper title is the primary text head because all subsequent material relates and elaborates on this one topic. If there are two or more sub-topics, the next level head (uppercase Roman numerals) should be used and, conversely, if there are not at least two sub-topics, then no subheads should be introduced.

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TABLE I
TABLE TYPE STYLES

Table Head	Table Column Head		
	Table column subhead	*Subhead*	*Subhead*
copy	More table copy[a]		

[a]Sample of a Table footnote.

Fig. 1. Example of a figure caption.

Figure Labels: Use 8 point Times New Roman for Figure labels. Use words rather than symbols or abbreviations when writing Figure axis labels to avoid confusing the reader. As an example, write the quantity "Magnetization", or "Magnetization, M", not just "M". If including units in the label, present them within parentheses. Do not label axes only with units. In the example, write "Magnetization (A/m)" or "Magnetization {A[m(1)]}", not just "A/m". Do not label axes with a ratio of quantities and units. For example, write "Temperature (K)", not "Temperature/K".

ACKNOWLEDGMENT

The preferred spelling of the word "acknowledgment" in America is without an "e" after the "g". Avoid the stilted expression "one of us (R. B. G.) thanks ...". Instead, try "R. B. G. thanks...". Put sponsor acknowledgments in the unnumbered footnote on the first page.

REFERENCES

Please number citations consecutively within brackets [**?**]. The sentence punctuation follows the bracket [**?**]. Refer simply to the reference number, as in [**?**]—do not use "Ref. [**?**]" or "reference [**?**]" except at the beginning of a sentence: "Reference [**?**] was the first ..."

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For papers published in translation journals, please give the English citation first, followed by the original foreign-language citation [**?**].

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