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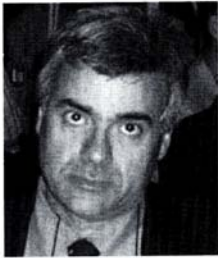


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Historical Corner



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Foreword from the Associate Editor

This issue hosts a very special researcher, Yasuto Mushiake, Professor Emeritus at Tohoku University and at Tohoku Institute of Technology, born on March 28, 1921. He first studied at the Hiroshima Higher Technical School, (presently, Hiroshima University), and then at the Tohoku Imperial University during World War II.

He graduated with Prof. Shintaro Uda (June 1, 1896 - August 18, 1976; Figure 1). Prof. Uda invented, with Prof. Hidetsugu Yagi (January 28, 1886 - January 19, 1976; Figure 2) the Yagi-Uda antenna, known and used worldwide. Indeed, the graduation work of Prof. Mushiake was on the practical design of this class of antennas. To this research he then added work on self-complementary antennas, in which he discovered the principle governing the input impedance.



Figure 1. Prof. Shintaro Uda (June 1, 1896 - August 18, 1976).



Figure 2. Prof. Hidetsugu Yagi (January 28, 1886 - January 19, 1976).

Notes on the History of the Yagi-Uda Antenna

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The first paper in English on the experimental study of the Yagi-Uda antenna was coauthored by H. Yagi and S. Uda in 1926 ([1] and Figure 1). However, all the works mentioned in its conclusions were published with the single name of S. Uda in the *Journal of the Institute of Electrical Engineers of Japan* before and after that paper. In spite of this truth, Yagi applied for a patent [2] with his single name, without telling anything to Uda. Moreover, it was found that the name of Uda had been omitted from the name of "Inventor."

Long after these events, in 1944, the subject of my graduate study, assigned by Prof. Uda, was to establish "Practicable Design Method for Yagi-Uda Antennas" [3]. In those days, there were controversial arguments about the optimum length of the parasitic directors. For this problem, I found out that the radius of the conductor brings decisive effects to its optimum length. Since then, my theoretical, numerical, and experimental studies were conducted keeping in mind the significant dependence of the wire thickness.

During such investigations, the slot antenna, as a low-profile radiator, became a leading project in Japan, and the slot antenna was included in our studies. For this new investigation, the importance of wire thickness evolved to the importance of an arbitrarily shaped slot antenna. The further evolution of such a conception led to the origination of the self-complementally structure and the discovery of its constant-impedance property in 1948 ([4] and Figure 2).

Just a few years later, due to the scheduled inauguration of television broadcasting in Japan, the research on practical Yagi-Uda antennas became urgent. Under such circumstances, the study of self-complementally antennas had to be temporarily suspended. However, owing to such a situation, a number of design charts [5], and numerical data about the dependence on wire thickness were accumulated. The results of those investigations and my graduate study were collected in a 1954 book, *Yagi-Uda Antenna* [6, 7].

Professor Uda ([8] and Figure 3) was always suggestive. He was a really respected mentor of me.

18. Projector of the Sharpest Beam of Electric Waves.

By Hidetsugu YAGI and Shintarō UDA.

Institute of Electrical Engineering, Tohoku Imperial University, Sendai.

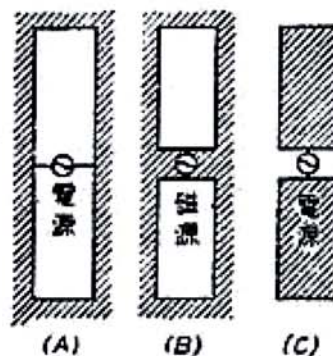
(Rec. Jan. 9, 1926. Comm. by Hantaro NAGAOKA, M.I.A., Jan. 12, 1926.)

Suppose that a vertical antenna is sending out electro magnetic wave in all directions around it. If a straight metallic rod of finite length be vertically erected within the field of its propagation, then the behavior of this metal rod will be as follows:—

When the length of this rod is equal to or slightly longer than a half wave length, the current induced in it will be in phase with or lagging behind the E.M.F. caused by the electric wave, and the rod will act as a "Wave reflector."

If, on the other hand, the length be made somewhat less than a half wave length, the current induced in it will be leading before the E. M. F., and the rod will act as a "Wave director".

Figure 1. The title page and first paragraphs of [1].



第1圖 細隙空中線と板状
空中線との関係

Figure 2. A figure showing a slot antenna and its complementary dipole (from [4]).



Figure 3. Prof. Shintaro Uda, about 1960, from the Tohoku University Archives: <http://webdb3.museum.tohoku.ac.jp/tua-photo/image/C004326-1.jpg>.

References and Notes

1. H. Yagi and S. Uda: "Projector of the Sharpest Beam of Electric Waves," *Proc. Imperial Academy of Japan*, February 1926.
2. H. Yagi, *Beam Projector of Electric Wave*, patent, applied for December 28, 1925, obtained August 13, 1926, in Japan, later transferred to Marconi Co.
3. Wikipedia, "Yagi-Uda Antenna," https://en.wikipedia.org/wiki/Yagi-Uda_antenna.
4. Y. Mushiake, "The Input Impedances of Slit Antennas," *J. IEE Japan*, **69**, 3, March 1949 (in Japanese); available at: <http://www.sm.rim.or.jp/~ymushiak/sub.docu.1.htm###>
5. "An Exact Step-Up Impedance-Ratio Chart," available at: <http://www.sm.rim.or.jp/~ymushiak/sub.ire.chart.htm>.
6. S. Uda and Y. Mushiake, *Yagi-Uda Antenna*, Tokyo, Maruzen Co. Ltd., 1954.
7. "Examples of Design Charts," available at: <http://www.sm.rim.or.jp/~ymushiak/sub.yua.charts.htm>.
8. J. E. Brittain, "Shintaro Uda and the Wave Projector," *Proc. IEEE*, May 1997, pp. 800-801. ㊦

Referred links

Figure 3. Prof. Shintaro Uda. <http://webdb3.museum.tohoku.ac.jp/tua-photo/image/C004326-1.jpg>
A better image. <http://www.sm.rim.or.jp/~ymushiak/sub.uda.image.2.htm>

- Ref. 3. https://en.wikipedia.org/wiki/Yagi-Uda_antenna
- Ref. 4. <http://www.sm.rim.or.jp/~ymushiak/sub.docu.1.htm###>
- Ref. 5. <http://www.sm.rim.or.jp/~ymushiak/sub.ire.chart.htm>
- Ref. 6. <http://www.sm.rim.or.jp/~ymushiak/sub.yubook.htm>
- Ref. 7. <http://www.sm.rim.or.jp/~ymushiak/sub.yua.charts.htm>