

## DAFTAR PUSTAKA

- [1] Y. Rahayu, I. P. Sari, D. I. Ramadhan, and R. Ngah, “High gain 5G MIMO antenna for mobile base station,” *Int. J. Electr. Comput. Eng.*, vol. 9, no. 1, p. 468, 2019, doi: 10.11591/ijece.v9i1.pp468-476.
- [2] E. Webster, “DEFINITION MIMO (multiple input, multiple output),” <https://searchmobilecomputing.techtarget.com/definition/MIMO>.
- [3] R. Chataut and R. Akl, “Massive MIMO systems for 5G and beyond networks—overview, recent trends, challenges, and future research direction,” *Sensors (Switzerland)*, vol. 20, no. 10, pp. 1–35, 2020, doi: 10.3390/s20102753.
- [4] Y. I. Shiddiqah, M. S. Muntini, R. Prasetyanto, and ..., “Analisis Pengaruh Antena MIMO 2Tx2Rx Terhadap Kecepatan Akses 4G LTE,” *J. Sains dan Seni ...*, vol. 5, no. 2, 2016, [Online]. Available: [http://ejurnal.its.ac.id/index.php/sains\\_seni/article/view/17090](http://ejurnal.its.ac.id/index.php/sains_seni/article/view/17090).
- [5] C. Craven, “What Is the 5G Spectrum? Definition,” <https://www.sdxcentral.com/5g/definitions/what-is-5g-spectrum/>, 2020.
- [6] G. M. S. Association, “Spectrum for terrestrial 5G networks: Licensing developments worldwide,” vol. 01, no. 01, pp. 1689–1699, 2018.
- [7] M. Abdullah-Al-Mamun, S. Datto, and M. Shahinur Rahman, “Performance Analysis of Rectangular, Circular and Elliptical Shape Microstrip Patch Antenna using Coaxial Probe Feed,” *2nd Int. Conf. Electr. Electron. Eng. ICEEE 2017*, no. December, pp. 1–4, 2018, doi: 10.1109/CEEE.2017.8412912.
- [8] L. D. Jatmiko, “Lebih Sulit Gelar 4G di Frekuensi 2,3 GHz Dibandingkan dengan 5G,” <https://teknologi.bisnis.com/read/20210521/101/1396382/lebih-sulit-gelar-4g-di-frekuensi-23-ghz-dibandingkan-dengan-5g>.
- [9] NetSim, “Introduction to 5G simulation with NetSim,”

[https://tetcos.com/help/v13.2/Technology-Libraries/5G.html#nr\\_frequency\\_bands](https://tetcos.com/help/v13.2/Technology-Libraries/5G.html#nr_frequency_bands).

- [10] Moniem Tech, “The Importance of Massive MIMO in 5G NR,” <https://moniem-tech.com/2020/12/29/what-is-the-importance-of-massive-mimo-in-5g-nr/>.
- [11] E. Mohyeldin, “Minimum Technical Performance Requirements for IMT-2020 radio interface ( s ) Eiman Mohyeldin ITU-R Workshop on IMT-2020 terrestrial radio interfaces,” 2016.
- [12] B. S. Nugroho, “Modul Praktikum Antena dan Propagasi 2018-2019,” <https://docs.google.com/document/d/1U6I0BEFhXa15jzxn09hGjgn5l85u7g5oaupHXWcfork/edit>, 2019.
- [13] Elprocus, “Antenna Gain – Directivity, Efficiency and Its Conversion,” 2013, [Online]. Available: <https://www.elprocus.com/antenna-gain-directivity-efficiency-and-its-conversion/>.
- [14] everythingRF, “What is Antenna Efficiency?,” [Online]. Available: <https://www.everythingrf.com/community/what-is-antenna-efficiency>.
- [15] W. L. Stutzman and G. A. Thiele, *Antenna Theory and Design*. 2012.
- [16] B. S. T. P. P. A. dan P. Sugesti, Erna Sri; Nugroho, “Modul Praktikum Antena dan Propagasi 2018 - 2019,” pp. 1–35, 2019.
- [17] R. Mishra, “An Overview of Microstrip,” *Int. J. Technol. Innov. Res.*, vol. 21, no. 2, pp. 1–17, 2016.
- [18] Z. Hasan and A. Zaman, “Design and Fabrication of a Circular Microstrip Patch Antenna for GPS Application,” vol. 7109, no. 1, pp. 54–57, 2017.
- [19] N. Aulia and K. Kunci, “Desain Antena Mikrostrip Array 2x4 dengan Teknik Pencatuan Proximity Coupled untuk Aplikasi 5G pada Frekuensi 2 , 6 GHz,” pp. 4–5, 2021.
- [20] Y. T. and C. K. M. Chen, “The Design of Broadband Patch Antenna on Different Substrates,” *IEEE Antennas Propag. Mag.* vol. 43, no. 2, pp. 39-

45, Apr. 2001. DOI 10.1109/74.918405.

- [21] D. MARLENA, “Rancang Bangun Defected Ground Structure ( Dgs ) Pada Antena Structure ( Dgs ) Pada Antena 2 Elemen,” 2008.
- [22] C. P. Frekuenasi, “Perancangan Dan Realisasi Antena Mimo Mikrostrip 4X4 Patch,” pp. 3–8, 2018.
- [23] L. M. RAMADHAN, “SIMULASI PERANCANGAN DAN ANALISIS MASSIVE MIMO ARRAY MIKROSTRIP PATCH RECTANGULAR DUALBAND 3,5 GHZ DAN 26 GHZ UNTUK KOMUNIKASI 5G,” *Apl. dan Anal. Lit. Fasilkom UI*, pp. 4–25, 2006.
- [24] F. Zhu, J. Xu, and Q. Xu, “Reduction of Mutual Coupling Between Closely-Packed Antenna Elements Using Defected Ground Structure,” *Reduct. Mutual Coupling Between Closely-Packed Antenna Elem. Using Defected Gr. Struct.*, pp. 4–7, 2009.
- [25] K. Wei, J. Y. Li, L. Wang, Z. J. Xing, and R. Xu, “Mutual coupling reduction of microstrip antenna array by periodic defected ground structures,” *APCAP 2016 - 2016 IEEE 5th Asia-Pacific Conf. Antennas Propagation, Conf. Proc.*, pp. 389–390, 2017, doi: 10.1109/APCAP.2016.7843257.
- [26] S. Andrian, “5G Fundamentals Massive MIMO,” <https://www.5g-indonesia.com/2020/08/penjelasan-lengkap-massive-mimo-5g.html>, 2020.
- [27] M. Gahadza and S. Winberg, “Performance of massive MIMO Systems for Future Generation Wireless Systems,” *2019 IEEE 10th Int. Conf. Mech. Intell. Manuf. Technol. ICMIMT 2019*, no. Icmimt, pp. 204–211, 2019, doi: 10.1109/ICMIMT.2019.8712054.
- [28] N. Ferdous, G. Chin Hock, H. A. S. Hamid, M. N. A. Raman, T. Sieh Kiong, and M. Ismail, “DESIGN OF A SMALL PATCH ANTENNA AT 3.5 GHZ FOR 5G APPLICATION,” *IOP Conf. Ser. Earth Environ. Sci.*, vol. 268, no. 1, 2019, doi: 10.1088/1755-1315/268/1/012152.
- [29] M. Rüsclin, T. Wittig, and Z. Iluz, “Phased antenna array design with CST STUDIO SUITE,” *2016 10th Eur. Conf. Antennas Propagation, EuCAP*

2016, no. October, 2016, doi: 10.1109/EuCAP.2016.7481530.