Bibliography

[1] "IEEE standard for definitions of terms for antennas," *IEEE Std 145-2013 (Revision of IEEE Std 145-1993)*, pp. 1–50, March 2014.

[2] C. A. Balanis, Antenna Theory: Analysis and Design, John Wiley & Sons, 2005.

[3] D. Schaubert, F. Farrar, A. Sindoris, and S. Hayes, "Microstrip antennas with frequency agility and polarization diversity," *IEEE Transactions on Antennas and Propagation*, vol. 29, no. 1, pp. 118–123, Jan. 1981.

[4] J. T. Bernhard, Reconfigurable Antennas, Morgan & Claypool, 2007.

[5] A. C. K. Mak, C. R. Rowell, R. D. Murch, and C. Mak, "Reconfigurable multiband antenna designs for wireless communication devices," *IEEE Transactions on Antennas and Propagation*, vol. 55, no. 7, pp. 1919–1928, July 2007.

[6] S. Zhang, G. Huff, J. Feng, and J. Bernhard, "A pattern reconfigurable microstrip parasitic array," *IEEE Transactions on Antennas and Propagation*, vol. 52, no. 10, pp. 2773–2776, Oct. 2004.

[7] B. Kim, B. Pan, S. Nikolaou, Y. Kim, J. Papapolymerou, and M. M. Tentzeris, "A novel single-feed circular microstrip antenna with reconfigurable polarization capability," *IEEE Transactions on Antennas and Propagation*, vol. 56, no. 3, pp. 630–638, March 2008.

[8] G. H. Huff, J. Feng, S. Zhang, and J. T. Bernhard, "A novel radiation pattern and frequency reconfigurable single turn square spiral microstrip antenna," *IEEE Microwave and Wireless Components Letters*, vol. 13, no. 2, pp. 57–59, Feb. 2003.

[9] C. J. Panagamuwa, A. Chauraya, and J. C. Vardaxoglou, "Frequency and beam reconfigurable antenna using photoconducting switches," *IEEE Transactions on Antennas and Propagation*, vol. 54, no. 2, pp. 449–454, Feb. 2006.

[10] S. Nikolaou, R. Bairavasubramanian, C. Lugo, I. Carrasquillo, D. C. Thompson, G. E. Ponchak, J. Papapolymerou, and M. M. Tentzeris, "Pattern and frequency reconfigurable annular slot antenna using PIN diodes," *IEEE Transactions on Antennas and Propagation*, vol. 54, no. 2, pp. 439–448, Feb. 2006.

[11] T. Guo, W. Leng, A. Wang, J. Li, and Q. Zhang, "A novel planar parasitic array antenna with frequency- and pattern-reconfigurable characteristics," *IEEE Antennas and Wireless Propagation Letters*, vol. 13, pp. 1569–1572, 2014.

[12] P. Qin, Y. J. Guo, Y. Cai, E. Dutkiewicz, and C. Liang, "A reconfigurable antenna with frequency and polarization agility," *IEEE Antennas and Wireless Propagation Letters*, vol. 10, pp. 1373–1376, 2011.

[13] N. Jin, F. Yang, and Y. Rahmat-Samii, "A novel patch antenna with switchable slot (PASS): dual-frequency operation with reversed circular polarizations," *IEEE Transactions on Antennas and Propagation*, vol. 54, no. 3, pp. 1031–1034, March 2006.

[14] W. L. Liu, T. R. Chen, S. H. Chen, and J. S. Row, "Reconfigurable microstrip antenna with pattern and polarisation diversities," *Electronics Letters*, vol. 43, no. 2, pp. 77–78, Jan. 2007.

[15] D. Rodrigo, B. A. Cetiner, and L. Jofre, "Frequency, radiation pattern and polarization reconfigurable antenna using a parasitic pixel layer," *IEEE Transactions on Antennas and Propagation*, vol. 62, no. 6, pp. 3422–3427, June 2014.

[16] L. Ge, Y. Li, J. Wang, and C. Y. D. Sim, "A low-profile reconfigurable cavity-backed slot antenna with frequency, polarization, and radiation pattern agility," *IEEE Transactions on Antennas and Propagation*, vol. 65, no. 5, pp. 2182–2189, May 2017.

[17] B. Dwivedy, S. K. Behera, and V. K. Singh, "A versatile triangular patch array for wideband frequency alteration with concurrent circular polarization and pattern reconfigurability," *IEEE Transactions on Antennas and Propagation*, vol. 67, no. 3, pp. 1640–1649, March 2019.

[18] C. G. Christodoulou, Y. Tawk, S. A. Lane, and S. R. Erwin, "Reconfigurable antennas for wireless and space applications," *Proceedings of the IEEE*, vol. 100, no. 7, pp. 2250–2261, July 2012.

[19] Z. Wu, H. Liu, and L. Li, "Metasurface-inspired low profile polarization reconfigurable antenna with simple DC controlling circuit," *IEEE Access*, vol. 7, pp. 45 073–45 079, 2019.

[20] S. Pendharker, R. K. Shevgaonkar, and A. N. Chandorkar, "Optically controlled frequency-reconfigurable microstrip antenna with low photoconductivity," *IEEE Antennas and Wireless Propagation Letters*, vol. 13, pp. 99–102, 2014.

[21] S. J. Mazlouman, M. Soleimani, A. Mahanfar, C. Menon, and R. G. Vaughan, "Pattern reconfigurable square ring patch antenna actuated by hemispherical dielectric elastomer," *Electronics Letters*, vol. 47, no. 3, pp. 164–165, Feb. 2011.

[22] W. Hu, M. Y. Ismail, R. Cahill, J. A. Encinar, V. F. Fusco, H. S. Gamble, D. Linton, R. Dickie, N. Grant, and S. P. Rea, "Liquid-crystal-based reflectarray antenna with electronically switchable monopulse patterns," *Electronics Letters*, vol. 43, no. 14, July 2007.

[23] D. M. Pozar and V. Sanchez, "Magnetic tuning of a microstrip antenna on a ferrite substrate," *Electronics Letters*, vol. 24, no. 12, pp. 729–731, June 1988.

[24] Z. Li, E. Ahmed, A. M. Eltawil, and B. A. Cetiner, "A beam-steering reconfigurable antenna for WLAN applications," *IEEE Transactions on Antennas and Propagation*, vol. 63, no. 1, pp. 24–32, Jan. 2015.

[25] M. A. Towfiq, I. Bahceci, S. Blanch, J. Romeu, L. Jofre, and B. A. Cetiner, "A reconfigurable antenna with beam steering and beamwidth variability for wireless communications," *IEEE Transactions on Antennas and Propagation*, vol. 66, no. 10, pp. 5052–5063, Oct. 2018.

[26] Y. You, K. L. Ford, J. M. Rigelsford, and T. O'Farrell, "Systems analysis of a pattern reconfigurable antenna for capacity improvement of cell edge users in cellular networks," *IEEE Transactions on Vehicular Technology*, vol. 67, no. 12, pp. 11 848–11 857, Dec. 2018.

[27] H. Kunsei, K. S. Bialkowski, M. S. Alam, and A. M. Abbosh, "Improved communications in underground mines using reconfigurable antennas," *IEEE Transactions on Antennas and Propagation*, vol. 66, no. 12, pp. 7505–7510, Dec. 2018.

[28] D. Piazza, P. Mookiah, M. D'Amico, and K. R. Dandekar, "Experimental analysis of pattern and polarization reconfigurable circular patch antennas for MIMO systems," *IEEE Transactions on Vehicular Technology*, vol. 59, no. 5, pp. 2352–2362, June 2010.

[29] S. Jeong and W. J. Chappell, "A city-wide smart wireless sewer sensor network using parasitic slot array antennas," *IEEE Antennas and Wireless Propagation Letters*, vol. 9, pp. 760–763, 2010.

[30] A. Darvazehban, S. A. Rezaeieh, A. Zamani, and A. M. Abbosh, "Pattern reconfigurable metasurface antenna for electromagnetic torso imaging," *IEEE Transactions on Antennas and Propagation*, pp. 1–1, 2019.

[31] S. Wolfe, S. Begashaw, Y. Liu, and K. R. Dandekar, "Adaptive link optimization for 802.11 UAV uplink using a reconfigurable antenna," in *IEEE Military Communications Conference (MILCOM)*, Oct. 2018, pp. 1–6.

[32] M. Burtowy, M. Rzymowski, and L. Kulas, "Low-profile ESPAR antenna for RSS-based DoA estimation in IoT applications," *IEEE Access*, vol. 7, pp. 17 403–17 411, 2019.

[33] Ansys, High Frequency Structure Simulator (HFSS), version 17.

[34] Z. N. Chen, D. Liu, H. Nakano, X. Qing, and T. Zwick, Handbook of Antenna Technologies, Springer, 2016.

[35] B. Y. Toh, R. Cahill, and V. F. Fusco, "Understanding and measuring circular polarization," *IEEE Transactions on Education*, vol. 46, no. 3, pp. 313–318, Aug. 2003.

[36] D. Wang, M. Wang, N. Xu, and W. Wu, "Improved measurement method of circularly-polarized antennas based on linear-component amplitudes," *Open Journal of Antennas and Propagation*, vol. 5, no. 1, pp. 36–45, 2017.

[37] G. G. S. Forte, G. Fontgalland, and S. E. Barbin, "Antenna polarization characterization with vector network analyzer measurements," in *International Conference on Electromagnetics in Advanced Applications (ICEAA)*, Sep. 2018, pp. 597–600.

[38] J. Li, Q. Zeng, R. Liu, and T. A. Denidni, "Beam-tilting antenna with negative refractive index metamaterial loading," *IEEE Antennas and Wireless Propagation Letters*, vol. 16, pp. 2030–2033, 2017.

[39] W. Cao, Y. Xiang, B. Zhang, A. Liu, T. Yu, and D. Guo, "A low-cost compact patch antenna with beam steering based on CSRR-loaded ground," *IEEE Antennas and Wireless Propagation Letters*, vol. 10, pp. 1520–1523, 2011.

[40] S. Sharif Iqbal Mitu and F. Sultan, "Beam scanning properties of a ferrite loaded microstrip patch antennas," *International Journal of Antennas and Propagation*, pp. 1–8, 2015.

[41] R. Guzman-Quiros, J. L. Gomez-Tornero, A. R. Weily, and Y. J. Guo, "Electronic full-space scanning with 1-D Fabry-Perot LWA using electromagnetic band-gap," *IEEE Antennas and Wireless Propagation Letters*, vol. 11, pp. 1426–1429, 2012.

[42] R. Guzman-Quiros, J. L. Gomez-Tornero, A. R. Weily, and Y. J. Guo, "Electronically steerable 1-D Fabry-Perot leaky-wave antenna employing a tunable high impedance surface," *IEEE Transactions on Antennas and Propagation*, vol. 60, no. 11, pp. 5046–5055, Nov. 2012.

[43] L. Y. Ji, Y. J. Guo, P. Y. Qin, S. X. Gong, and R. Mittra, "A reconfigurable partially reflective surface (PRS) antenna for beam steering," *IEEE Transactions on Antennas and Propagation*, vol. 63, no. 6, pp. 2387–2395, June 2015.

[44] A. Khidre, F. Yang, and A. Elsherbeni, "Circularly polarized beam-scanning microstrip antenna using a reconfigurable parasitic patch of tunable electrical size," *IEEE Transactions on Antennas and Propagation*, vol. 63, no. 7, pp. 2858–2866, July 2015.

[45] J. Huang and A. Densmore, "Microstrip Yagi array antenna for mobile satellite vehicle application," *IEEE Transactions on Antennas and Propagation*, vol. 39, no. 7, pp. 1024–1030, July 1991.

[46] P.-Y. Qin, Y. Guo, and C. Ding, "A beam switching quasi-Yagi dipole antenna," *IEEE Transactions on Antennas and Propagation*, vol. 61, no. 10, pp. 4891–4899, Oct. 2013.

[47] T. Sabapathy, M. F. B. Jamlos, R. B. Ahmad, M. Jusoh, M. I. Jais, and M. R. Kamarudin, "Electronically reconfigurable beam steering antenna using embedded RF PIN based parasitic arrays (ERPPA)," *Progress in Electromagnetics Research*, vol. 140, pp. 241–261, 2013.

[48] T. Sabapathy, M. Jusoh, R. B. Ahmad, M. R. Kamarudin, and P. J. Soh, "A ground-plane-truncated, broadly steerable Yagi-Uda patch array antenna," *IEEE Antennas and Wireless Propagation Letters*, vol. 15, pp. 1069–1072, 2016.

[49] Z. Li, I. Bahceci, and B. A. Cetiner, "Broadband beam-steering reconfigurable antenna," *Microwave and Optical Technology Letters*, vol. 59, no. 1, pp. 63–65, 2017.

[50] Y. Yusuf and X. Gong, "A low-cost patch antenna phased array with analog beam steering using mutual coupling and reactive loading," *IEEE Antennas and Wireless Propagation Letters*, vol. 7, pp. 81–84, 2008.

[51] M. H. C. Dias, V. Freitas, and T.-P. Vuong, "Low cost electronic beam tilting of microstrip antennas by the use of tunable parasites," *Microwave and Optical Technology Letters*, vol. 57, no. 11, pp. 2710–2713, 2015.

[52] M. R. Nikkhah, J. Rashed-Mohassel, and A. A. Kishk, "Compact low-cost phased array of dielectric resonator antenna using parasitic elements and capacitor loading," *IEEE Transactions on Antennas and Propagation*, vol. 61, no. 4, pp. 2318–2321, April 2013.

[53] R. Harrington, "Reactively controlled directive arrays," *IEEE Transactions on Antennas and Propagation*, vol. 26, no. 3, pp. 390–395, May 1978.

[54] T. Ohira and K. Iigusa, "Electronically steerable parasitic array radiator antenna," *Electronics and Communications in Japan (Part II: Electronics)*, vol. 87, no. 10, pp. 25–45, 2004.

[55] J. J. Luther, S. Ebadi, and X. Gong, "A microstrip patch electronically steerable parasitic array radiator (ESPAR) antenna with reactance-tuned coupling and maintained resonance," *IEEE Transactions on Antennas and Propagation*, vol. 60, no. 4, pp. 1803–1813, April 2012.

[56] J. J. Luther, S. Ebadi, and X. Gong, "A low-cost 2x2 planar array of three-element microstrip electrically steerable parasitic array radiator (ESPAR) subcells," *IEEE Transactions on Microwave Theory and Techniques*, vol. 62, no. 10, pp. 2325–2336, Oct. 2014.

[57] D.-T. Nguyen, R. Siragusa, and S. Tedjini, "Beam steering patch antenna using reactive loading and Yagi-antenna concept," *Microwave and Optical Technology Letters*, vol. 57, no. 2, pp. 417–421, 2015.

[58] C.-C. Hu, C. F. Jou, and J.-J. Wu, "A two-dimensional beam-scanning linear active leaky-wave antenna array," *IEEE Microwave and Guided Wave Letters*, vol. 9, no. 3, pp. 102–104, 1999.

[59] S. Beer, P. Pahl, T. Zwick, and S. Koch, "Two-dimensional beam steering based on the principle of holographic antennas," in *International Workshop on Antenna Technology (iWAT)*, March 2011, pp. 210–213.

[60] D. F. Sievenpiper, J. H. Schaffner, H. J. Song, R. Y. Loo, and G. Tangonan, "Two-dimensional beam steering using an electrically tunable impedance surface," *IEEE Transactions on Antennas and Propagation*, vol. 51, no. 10, pp. 2713–2722, Oct. 2003.

[61] M. Bouslama, M. Traii, T. A. Denidni, and A. Gharsallah, "Beam-switching antenna with a new reconfigurable frequency selective surface," *IEEE Antennas and Wireless Propagation Letters*, vol. 15, pp. 1159–1162, 2016.

[62] A. Khidre, F. Yang, and A. Z. Elsherbeni, "Reconfigurable microstrip antenna with two-dimensional scannable beam," in *2013 IEEE Antennas and Propagation Society International Symposium (APSURSI)*, July 2013, pp. 196–197.

[63] R. Guzmán-Quirós, A. Weily, J. Gomez-Tornero, and Y. Guo, "A Fabry-Perot antenna with two-dimensional electronic beam scanning," *IEEE Transactions on Antennas and Propagation*, vol. 64, no. 4, pp. 1536–1541, April 2016.

[64] A. Dadgarpour, B. Zarghooni, B. S. Virdee, and T. A. Denidni, "One- and two-dimensional beam-switching antenna for millimeter-wave MIMO applications," *IEEE Transactions on Antennas and Propagation*, vol. 64, no. 2, pp. 564–573, Feb. 2016.

[65] L. Ge, K. M. Luk, and S. Chen, "360° beam-steering reconfigurable wideband substrate integrated waveguide horn antenna," *IEEE Transactions on Antennas and Propagation*, vol. 64, no. 12, pp. 5005–5011, Dec. 2016.

[66] Z. L. Lu, X. X. Yang, and G. N. Tan, "A multidirectional pattern-reconfigurable patch antenna with CSRR on the ground," *IEEE Antennas and Wireless Propagation Letters*, vol. 16, pp. 416–419, 2017.

[67] S. S. Nair and M. J. Ammann, "Reconfigurable antenna with elevation and azimuth beam switching," *IEEE Antennas and Wireless Propagation Letters*, vol. 9, pp. 367–370, 2010.

[68] B. Tsai and S. Y. Chen, "Design of beam-steerable parasitic patch arrays using variable reactive loads," in *IEEE 4th Asia-Pacific Conference on Antennas and Propagation (APCAP)*, June 2015, pp. 423–424.

[69] W. Ouyang and X. Gong, "Cavity-backed slot ESPAR cross array with two-dimensional beam steering control," in *IEEE International Symposium on Antennas and Propagation USNC/URSI National Radio Science Meeting*, July 2017, pp. 307–308.

[70] R. Movahedinia, M. R. Chaharmir, A. R. Sebak, M. R. Nikkhah, and A. A. Kishk, "Realization of large dielectric resonator antenna ESPAR," *IEEE Transactions on Antennas and Propagation*, vol. 65, no. 7, pp. 3744–3749, July 2017.

[71] S. Jeong, D. Ha, and W. J. Chappell, "A planar parasitic array antenna for tunable radiation pattern," in *IEEE Antennas and Propagation Society International Symposium*, June 2009, pp. 1–4.

[72] Y. Urata, M. Haneishi, and Y. Kimura, "Beam-adjustable planar arrays composed of microstrip antennas," *Electronics and Communications in Japan (Part II: Electronics)*, vol. 87, no. 10, pp. 1–12, 2004.

[73] M. Jusoh, T. Sabapathy, M. F. Jamlos, and M. R. Kamarudin, "Reconfigurable four-parasitic-elements patch antenna for high-gain beam switching application," *IEEE Antennas and Wireless Propagation Letters*, vol. 13, pp. 79–82, 2014.

[74] M. Jusoh, T. Aboufoul, T. Sabapathy, A. Alomainy, and M. R. Kamarudin, "Pattern-reconfigurable microstrip patch antenna with multidirectional beam for WiMax application," *IEEE Antennas and Wireless Propagation Letters*, vol. 13, pp. 860–863, 2014.

[75] Y. Yang and X. Zhu, "A wideband reconfigurable antenna with 360° beam steering for 802.11ac WLAN applications," *IEEE Transactions on Antennas and Propagation*, vol. 66, no. 2, pp. 600–608, Feb. 2018.

[76] M. S. Alam and A. M. Abbosh, "Beam-steerable planar antenna using circular disc and four PIN-controlled tapered stubs for WiMAX and WLAN applications," *IEEE Antennas and Wireless Propagation Letters*, vol. 15, pp. 980–983, 2016.

[77] M. S. Alam and A. M. Abbosh, "Planar pattern reconfigurable antenna with eight switchable beams for WiMax and WLAN applications," *IET Microwaves, Antennas & Propagation*, vol. 10, no. 10, pp. 1030–1035, 2016.

[78] M. S. Alam and A. M. Abbosh, "Wideband pattern-reconfigurable antenna using pair of radial radiators on truncated ground with switchable director and reflector," *IEEE Antennas and Wireless Propagation Letters*, vol. 16, pp. 24–28, 2017.

[79] P. Lotfi, S. Soltani, and R. D. Murch, "Broadside beam-steerable planar parasitic pixel patch antenna," *IEEE Transactions on Antennas and Propagation*, vol. 64, no. 10, pp. 4519–4524, Oct. 2016.

[80] M. S. Alam, Y. Wang, N. Nguyen-Trong, and A. Abbosh, "Compact circular reconfigurable antenna for high directivity and 360° beam scanning," *IEEE Antennas and Wireless Propagation Letters*, vol. 17, pp. 1492–1496, 2018.

[81] S. Chen, P. Qin, W. Lin, and Y. J. Guo, "Pattern-reconfigurable antenna with five switchable beams in elevation plane," *IEEE Antennas and Wireless Propagation Letters*, vol. 17, no. 3, pp. 454–457, March 2018.

[82] Y. Li and K. Luk, "A linearly polarized magnetoelectric dipole with wide H-plane beamwidth," *IEEE Transactions on Antennas and Propagation*, vol. 62, no. 4, pp. 1830–1836, April 2014.

[83] L. Ge and K. M. Luk, "A three-element linear magneto-electric dipole array with beamwidth reconfiguration," *IEEE Antennas and Wireless Propagation Letters*, vol. 14, pp. 28–31, 2015.

[84] L. Ge and K. M. Luk, "Linearly polarized and dual-polarized magneto-electric dipole antennas with reconfigurable beamwidth in the H-plane," *IEEE Transactions on Antennas and Propagation*, vol. 64, no. 2, pp. 423–431, Feb. 2016.

[85] L. Ge and K. M. Luk, "Beamwidth reconfigurable magneto-electric dipole antenna based on tunable strip grating reflector," *IEEE Access*, vol. 4, pp. 7039–7045, 2016.

[86] B. Feng, Y. Tu, K. L. Chung, and Q. Zeng, "A beamwidth reconfigurable antenna array with triple dual-polarized magneto-electric dipole elements," *IEEE Access*, vol. 6, pp. 36 083–36 091, 2018.

[87] Y. Shi, Y. Cai, J. Yang, and L. Li, "A magnetoelectric dipole antenna with beamwidth reconfiguration," *IEEE Antennas and Wireless Propagation Letters*, vol. 18, no. 4, pp. 621–625, April 2019.

[88] A. Edalati and T. A. Denidni, "Reconfigurable beamwidth antenna based on active partially reflective surfaces," *IEEE Antennas and Wireless Propagation Letters*, vol. 8, pp. 1087–1090, 2009.

[89] T. Debogovic, J. Perruisseau-Carrier, and J. Bartolic, "Partially reflective surface antenna with dynamic beamwidth control," *IEEE Antennas and Wireless Propagation Letters*, vol. 9, pp. 1157–1160, 2010.

[90] T. Debogović, J. Bartolić, and J. Perruisseau-Carrier, "Dual-polarized partially reflective surface antenna with MEMS-based beamwidth reconfiguration," *IEEE Transactions on Antennas and Propagation*, vol. 62, no. 1, pp. 228–236, Jan. 2014.

[91] I. A. Korisch and B. Rulf, "Antenna beamwidth control using parasitic subarrays," in *IEEE-APS Conference on Antennas and Propagation for Wireless Communications*, Nov. 2000, pp. 117–120.

[92] A. Khidre, F. Yang, and A. Z. Elsherbeni, "Reconfigurable microstrip antenna with tunable radiation beamwidth," in *IEEE Antennas and Propagation Society International Symposium (APSURSI)*, July 2013, pp. 1444–1445.

[93] M. Saitoh, N. Honma, and T. Murakami, "Impact of radiation pattern control of MIMO antenna on interfered multicell environment," *IEEE Antennas and Wireless Propagation Letters*, vol. 15, pp. 666–669, 2016.

[94] S.-N. Lee, J. Kim, J.-G. Yook, Y. C. Hu, and D. Peroulis, "A variable beamwidth antenna for wireless mesh networks," in *IEEE Antennas and Propagation Society International Symposium*, June 2007, pp. 493–496.

[95] H. N. Chu and T. Ma, "Beamwidth switchable planar microstrip series-fed slot array using reconfigurable synthesized transmission lines," *IEEE Transactions on Antennas and Propagation*, vol. 65, no. 7, pp. 3766–3771, July 2017.

[96] D.-W. Kim and S.-S. Oh, "Design of a coupler with three reconfigurable output ports and a beamwidth reconfigurable antenna," *International Journal of Antennas and Propagation*, pp. 1–8, 2017.

[97] C. Tsai and J. Row, "Beamwidth reconfigurable slotted-patch antennas," in *IEEE 5th Asia-Pacific Conference on Antennas and Propagation (APCAP)*, July 2016, pp. 149–150.

[98] M. Wang, C. Huang, P. Chen, Y. Wang, Z. Zhao, and X. Luo, "Controlling beamwidth of antenna using frequency selective surface superstrate," *IEEE Antennas and Wireless Propagation Letters*, vol. 13, pp. 213–216, 2014.

[99] J. Zhang, S. Zhang, and G. F. Pedersen, "E-plane beam width reconfigurable dipole antenna with tunable parasitic strip," in *12th European Conference on Antennas and Propagation (EuCAP)*, April 2018, pp. 1–3.

[100] T. Debogović and J. Perruisseau-Carrier, "Array-fed partially reflective surface antenna with independent scanning and beamwidth dynamic control," *IEEE Transactions on Antennas and Propagation*, vol. 62, no. 1, pp. 446–449, Jan. 2014.

[101] S. Lim, C. Caloz, and T. Itoh, "Metamaterial-based electronically controlled transmission-line structure as a novel leaky-wave antenna with tunable radiation angle and beamwidth," *IEEE Transactions on Microwave Theory and Techniques*, vol. 53, no. 1, pp. 161–173, Jan. 2005.

[102] G. Yang, J. Li, D. Wei, S. Zhou, and R. Xu, "Pattern reconfigurable microstrip antenna with multidirectional beam for wireless communication," *IEEE Transactions on Antennas and Propagation*, vol. 67, no. 3, pp. 1910–1915, March 2019.

[103] J. Wang, J. Yin, H. Wang, C. Yu, and W. Hong, "Wideband U-slot patch antenna with reconfigurable radiation pattern," in *11th European Conference on Antennas and Propagation (EuCAP)*, March 2017, pp. 611–615.

[104] W. Deng, X. Yang, C. Shen, J. Zhao, and B. Wang, "A dual-polarized pattern reconfigurable Yagi patch antenna for microbase stations," *IEEE Transactions on Antennas and Propagation*, vol. 65, no. 10, pp. 5095–5102, Oct. 2017.

[105] H. Zhou, A. Pal, A. Mehta, D. Mirshekar-Syahkal, and H. Nakano, "A four-arm circularly polarized high-gain high-tilt beam curl antenna for beam steering applications," *IEEE Antennas and Wireless Propagation Letters*, vol. 17, pp. 1034–1038, 2018.

[106] M. A. Sharkawy and A. A. Kishk, "Wideband beam-scanning circularly polarized inclined slots using ridge gap waveguide," *IEEE Antennas and Wireless Propagation Letters*, vol. 13, pp. 1187–1190, 2014.

[107] H. Liu, S. Gao, and T. H. Loh, "Low-cost beam-switching circularly-polarised antenna using tunable high impedance surface," in *Loughborough Antennas Propagation Conference (LAPC)*, Nov. 2012, pp. 1–3.

[108] D. F. Guan, P. You, Q. Zhang, Z. H. Lu, S. W. Yong, and K. Xiao, "A wide-angle and circularly polarized beam-scanning antenna based on microstrip spoof surface plasmon polariton transmission line," *IEEE Antennas and Wireless Propagation Letters*, vol. 16, pp. 2538–2541, 2017.

[109] Y. Wen, B. Wang, and X. Ding, "Wide-beam circularly polarized microstrip magnetic-electric dipole antenna for wide-angle scanning phased array," *IEEE Antennas and Wireless Propagation Letters*, vol. 16, pp. 428–431, 2017.

[110] W. Lin, H. Wong, and R. W. Ziolkowski, "Circularly polarized antenna with reconfigurable broadside and conical beams facilitated by a mode switchable feed network," *IEEE Transactions on Antennas and Propagation*, vol. 66, no. 2, pp. 996–1001, Feb. 2018.

[111] Y. Lyu, F. Meng, G. Yang, D. Erni, Q. Wu, and K. Wu, "Periodic SIW leaky-wave antenna with large circularly polarized beam scanning range," *IEEE Antennas and Wireless Propagation Letters*, vol. 16, pp. 2493–2496, 2017.

[112] L. Di Palma, A. Clemente, L. Dussopt, R. Sauleau, P. Potier, and P. Pouliguen, "Circularly-polarized reconfigurable transmitarray in Ka-band with beam scanning and polarization switching capabilities," *IEEE Transactions on Antennas and Propagation*, vol. 65, no. 2, pp. 529–540, Feb. 2017.

[113] M. Karimipour and N. Komjani, "Realization of multiple concurrent beams with independent circular polarizations by holographic reflectarray," *IEEE Transactions on Antennas and Propagation*, vol. 66, no. 9, pp. 4627–4640, Sep. 2018.

[114] W. W. Li and K. W. Leung, "Omnidirectional circularly polarized dielectric resonator antenna with top-loaded alford loop for pattern diversity design," *IEEE Transactions on Antennas and Propagation*, vol. 61, no. 8, pp. 4246–4256, Aug. 2013.

[115] R. Movahedinia, A. R. Sebak, M. R. Chaharmir, M. R. Nikkhah, and A. A. Kishk, "X-band circularly polarized electronically steerable parasitic array radiator of DRA," *IEEE Transactions on Antennas and Propagation*, vol. 66, no. 2, pp. 721–728, Feb. 2018.

[116] S. Sheel and J. Coetzee, "Electronically steerable circularly polarized planar antenna," in *12th European Conference on Antennas and Propagation (EuCAP)*, April 2018, pp. 1–4.

[117] M. Akbari, M. Farahani, A. R. Sebak, and T. A. Denidni, "A 30GHz high-gain circularly-polarized patten-steerable antenna based on parasitic patches," in *11th European Conference on Antennas and Propagation (EuCAP)*, March 2017, pp. 3044–3046.

[118] A. Miura, W. Luo, M. Taromaru, M. Ueba, and T. Ohira, "Experimental study of reactively loaded parasitic microstrip array antenna for circular polarization," in *2nd European Conference on Antennas and Propagation, (EuCAP)*, Nov. 2007, pp. 1–5.

[119] H. Liu, S. Gao, and T. H. Loh, "Circularly polarized electronically steerable parasitic array radiator antenna for satellite," in *4th European Conference on Antennas and Propagation (EuCAP)*, April 2010, pp. 1–4.

[120] W. Cao, B. Zhang, A. Liu, T. Yu, D. Guo, and K. Pan, "A reconfigurable microstrip antenna with radiation pattern selectivity and polarization diversity," *IEEE Antennas and Wireless Propagation Letters*, vol. 11, pp. 453–456, 2012.

[121] Y. Yang, R. B. V. B. Simorangkir, X. Zhu, K. Esselle, and Q. Xue, "A novel boresight and conical pattern reconfigurable antenna with the diversity of 360° polarization scanning," *IEEE Transactions on Antennas and Propagation*, vol. 65, no. 11, pp. 5747–5756, Nov. 2017.

[122] J. Row and Y. Huang, "Reconfigurable antenna with switchable broadside and conical beams and switchable linear polarized patterns," *IEEE Transactions on Antennas and Propagation*, vol. 66, no. 7, pp. 3752–3756, July 2018.

[123] M. Ali, A. T. M. Sayem, and V. K. Kunda, "A reconfigurable stacked microstrip patch antenna for satellite and terrestrial links," *IEEE Transactions on Vehicular Technology*, vol. 56, no. 2, pp. 426–435, March 2007.

[124] N. Nguyen-Trong, A. T. Mobashsher, and A. M. Abbosh, "Reconfigurable shorted patch antenna with polarization and pattern diversity," in *Australian Microwave Symposium (AMS)*, Feb. 2018, pp. 27–28.

[125] S. Raman, P. Mohanan, N. Timmons, and J. Morrison, "Microstrip-fed pattern- and polarization- reconfigurable compact truncated monopole antenna," *IEEE Antennas and Wireless Propagation Letters*, vol. 12, pp. 710–713, 2013.

[126] C. Sulakshana and L. Anjaneyulu, "A compact reconfigurable antenna with frequency, polarization and pattern diversity," *Journal of Electromagnetic Waves and Applications*, vol. 29, no. 15, pp. 1953–1964, 2015.

[127] K. Yang, A. Loutridis, X. Bao, G. Ruvio, and M. J. Ammann, "Printed inverted-F antenna with reconfigurable pattern and polarization," in *10th European Conference on Antennas and Propagation (EuCAP)*, April 2016, pp. 1–5.

[128] A. Narbudowicz, X. Bao, and M. J. Ammann, "Omnidirectional microstrip patch antenna with reconfigurable pattern and polarisation," *IET Microwaves, Antennas & Propagation*, vol. 8, no. 11, pp. 872–877, 2014.

[129] W. Chen, J. Sun, and Z. Feng, "A novel compact reconfigurable polarization and pattern antenna," *Microwave and Optical Technology Letters*, vol. 49, no. 11, pp. 2802–2805, 2007.

[130] X. Yi, L. Huitema, and H. Wong, "Polarization and pattern reconfigurable cuboid quadrifilar helical antenna," *IEEE Transactions on Antennas and Propagation*, vol. 66, no. 6, pp. 2707–2715, June 2018.

[131] P. Vasina, T. Mikulasek, J. Lacik, and H. Arthaber, "Beam- and polarisation-reconfigurable SIW ring-slot antenna array," *IET Microwaves, Antennas Propagation*, vol. 12, no. 15, pp. 2313–2319, 2018.

[132] F. Sun, F. Zhang, and C. Feng, "A microstrip antenna for polarized diversity and pattern selectivity application," in *2018 International Conference on Microwave and Millimeter Wave Technology (ICMMT)*, May 2018, pp. 1–4.

[133] S. L. Chen, P. Y. Qin, C. Ding, and Y. J. Guo, "Cavity-backed proximity-coupled reconfigurable microstrip antenna with agile polarizations and steerable beams," *IEEE Transactions on Antennas and Propagation*, vol. 65, no. 10, pp. 5553–5558, Oct. 2017.

[134] A. N'gom, A. Diallo, K. Talla, A. Chaibo, I. Dioum, J. M. Ribero, and A. C. Beye, "A reconfigurable beam dual polarized microstrip cross patch antenna," in *11th European Conference on Antennas and Propagation (EuCAP)*, March 2017, pp. 3135–3139.

[135] C. Gu, S. Gao, H. Liu, Q. Luo, T. H. Loh, M. Sobhy, J. Li, G. Wei, J. Xu, F. Qin, B. Sanz-Izquierdo, and R. A. Abd-Alhameed, "Compact smart antenna with electronic beam-switching and reconfigurable polarizations," *IEEE Transactions on Antennas and Propagation*, vol. 63, no. 12, pp. 5325–5333, Dec. 2015.

[136] G. B. Zhang, R. C. Gough, M. R. Moorefield, K. J. Cho, A. T. Ohta, and W. A. Shiroma, "A liquid-metal polarization-pattern-reconfigurable dipole antenna," *IEEE Antennas and Wireless Propagation Letters*, vol. 17, pp. 50–53, 2018.

[137] P. Xie, G. Wang, H. Li, and J. Liang, "A dual-polarized two-dimensional beam-steering Fabry–Pérot cavity antenna with a reconfigurable partially reflecting surface," *IEEE Antennas and Wireless Propagation Letters*, vol. 16, pp. 2370–2374, 2017.

[138] A. Chen, X. Ning, L. Wang, and Z. Zhang, "A design of radiation pattern and polarization reconfigurable antenna using metasurface," in *IEEE Asia Pacific Microwave Conference (APMC)*, Nov. 2017, pp. 108–111.

[139] J. Hu and Z. Hao, "A compact polarization-reconfigurable and 2-D beam-switchable antenna using the spatial phase shift technique," *IEEE Transactions on Antennas and Propagation*, vol. 66, no. 10, pp. 4986–4995, Oct. 2018.

[140] M. Allayioti, J. R. Kelly, and R. Mittra, "Beam and polarization reconfigurable microstrip antenna based on parasitics," *Microwave and Optical Technology Letters*, vol. 60, no. 6, pp. 1460–1464, 2018.

[141] X. Yuan, Z. Li, D. Rodrigo, H. S. Mopidevi, O. Kaynar, L. Jofre, and B. A. Cetiner, "A parasitic layer-based reconfigurable antenna design by multi-objective optimization," *IEEE Transactions on Antennas and Propagation*, vol. 60, no. 6, pp. 2690–2701, June 2012.

[142] M. M. Fakharian, P. Rezaei, and A. A. Orouji, "Polarization and radiation pattern reconfigurability of a planar monopole-fed loop antenna for GPS application," *Radioengineering*, vol. 25, no. 4, pp. 680–686, Dec. 2016.

[143] Y. P. Selvam, L. Elumalai, M. G. N. Alsath, M. Kanagasabai, S. Subbaraj, and S. Kingsly, "Novel frequency- and pattern-reconfigurable rhombic patch antenna with switchable polarization," *IEEE Antennas and Wireless Propagation Letters*, vol. 16, pp. 1639–1642, 2017.

[144] Y. P. Selvam, M. G. N. Alsath, M. Kanagasabai, L. Elumalai, S. K. Palaniswamy, S. Subbaraj, S. Kingsly, G. Konganathan, and I. Kulandhaisamy, "A patch-slot antenna

array with compound reconfiguration," *IEEE Antennas and Wireless Propagation Letters*, vol. 17, pp. 525–528, 2018.

[145] X. Yang, B. Wang, S. H. Yeung, Q. Xue, and K. F. Man, "Circularly polarized reconfigurable crossed-Yagi patch antenna," *IEEE Antennas and Propagation Magazine*, vol. 53, no. 5, pp. 65–80, Oct. 2011.

[146] B. Babakhani, S. K. Sharma, and N. R. Labadie, "A frequency agile microstrip patch phased array antenna with polarization reconfiguration," *IEEE Transactions on Antennas and Propagation*, vol. 64, no. 10, pp. 4316–4327, Oct. 2016.

[147] G. Yang, J. Li, B. Cao, D. Wei, S. Zhou, and J. Deng, "A compact reconfigurable microstrip antenna with multidirectional beam and multipolarization," *IEEE Transactions on Antennas and Propagation*, vol. 67, no. 2, pp. 1358–1363, Feb. 2019.

[148] Coilcraft, Data Sheet of 4310LC-132KEB Wideband Bias Choke. Available: https://www.coilcraft.com/pdfs/4310lc.

[149] N. Behdad and K. Sarabandi, "Dual-band reconfigurable antenna with a very wide tunability range," *IEEE Transactions on Antennas and Propagation*, vol. 54, no. 2, pp. 409–416, Feb. 2006.

[150] F. Yang and Y. Rahmat-Samii, "Patch antennas with switchable slots (PASS) in wireless communications: concepts, designs, and applications," *IEEE Antennas and Propagation Magazine*, vol. 47, no. 2, pp. 13–29, April 2005.

[151] A. Khidre, F. Yang, and A. Elsherbeni, "A patch antenna with a varactor-loaded slot for reconfigurable dual-band operation," *IEEE Transactions on Antennas and Propagation*, vol. 63, no. 2, pp. 755–760, Feb. 2015.

[152] J. Hu, G. Q. Luo, and Z. Hao, "A wideband quad-polarization reconfigurable metasurface antenna," *IEEE Access*, vol. 6, pp. 6130–6137, 2018.

[153] Skyworks Solutions, Data Sheet of SMV123x Series: Hyperabrupt Junction Tuning Varactors. Available: http://www.skyworksinc.com/uploads/documents/200058Q.

[154] S. V. Hum and H. Y. Xiong, "Analysis and design of a differentially-fed frequency agile microstrip patch antenna," *IEEE Transactions on Antennas and Propagation*, vol. 58, no. 10, pp. 3122–3130, Oct. 2010.

[155] K. Tekkouk, J. Hirokawa, R. Sauleau, and M. Ando, "Wideband and large coverage continuous beam steering antenna in the 60-GHz band," *IEEE Transactions on Antennas and Propagation*, vol. 65, no. 9, pp. 4418–4426, Sep. 2017.

[156] R. Q. Lee, R. Acosta, J. Dahele, and K. Lee, "An experimental investigation of parasitic microstrip arrays," *paper presented at the 1987 Antennas Application Symposium, Monticello, IL.*, 1987.

[157] M. Isa, A. Azmi, A. Isa, M. Zin, S. Saat, Z. Zakaria, M. Abu, and A. Ahmad, "Comparative study of mutual coupling on microstrip antennas for wireless local area network (WLAN) application," *Journal of Telecommunication, Electronic and Computer Engineering (JTEC)*, vol. 7, no. 2, pp. 161–167, 2015.

[158] R. Jedlicka, M. Poe, and K. Carver, "Measured mutual coupling between microstrip antennas," *IEEE Transactions on Antennas and Propagation*, vol. 29, no. 1, pp. 147–149, Jan. 1981.

[159] K. Murata, H. Tsuboi, K. Iwata, and T. Abe, "Microstrip antenna and high frequency sensor using microstrip antenna," Aug. 10 2010, US Patent 7,773,035.

[160] R. Movahedinia, M. R. Chaharmir, A. R. Sebak, M. R. Nikkhah, and A. A. Kishk, "Realization of large dielectric resonator antenna ESPAR," *IEEE Transactions on Antennas and Propagation*, vol. 65, no. 7, pp. 3744–3749, July 2017.

[161] G. Kumar and K. P. Ray, Broadband Microstrip Antennas, Artech House, 2003.

[162] Analog Devices, Data Sheet of HMC241AQS16 SP4T non-reflective Switch. Available: https://www.analog.com/media/en/technical-documentation/data-sheets/hmc241aqs16e.

[163] Analog Devices, Data Sheet of HMC435AMS8G SPDT non-reflective Switch. Available: https://www.analog.com/media/en/technical-documentation/data-sheets/hmc435a.