

## **Techniques for Tilted-beam Antenna Design**

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Techniques for realizing tilted-beam antennas for modern wireless communications systems have been receiving considerable attention. This short course presents recent progress in tilted-beam antennas, and is composed of three chapters. Chapter 1 describes the fundamental concepts behind realizing a tilted beam. Chapter 2 summarizes the analysis methods for tilted-beam antennas. Chapter 3 presents several representative tilted-beam antennas, including (a) a rhombic grid array antenna, (b) a leaky wave antenna using a metamaterial (MTM) transmission line, (c) an inverted F antenna with an electromagnetic-band-gap (EBG) reflector, (d) a bent two-leaf (BeToL) antenna and a four-leaf (BeFoL) antenna, (e) an eight-beam reconfigurable antenna composed of a fed patch and parasitic T elements, (f) a patch antenna with a Fabry-Perot resonant plate, (g) an external-excitation spiral antenna, and (h) a cavity-fed spiral array antenna and a cavity-fed helical array antenna, both with extremely high aperture efficiency. Note that antennas (a) through (f) radiate a linearly-polarized tilted beam, and antennas (g) and (h) radiate a circularly-polarized tilted beam, with all antennas having a small antenna height above the ground plane (low-profile structure).