

A new technique is introduced for evaluating the vector potential of circular loop antennas (CLAs) with arbitrary current distribution and dimensions, which can be used to obtain the exact electromagnetic fields in near and far regions of the antenna. The technique is based on the spherical Bessel functions (SBFs) and associated Legendre polynomials (ALPs) expansion. This expansion is used to decouple the azimuth variables of the integrand of the vector potential integrals from the other variables in a separate functions that depend exponentially on azimuth variables. This technique reduces greatly the mathematical operations for evaluation of the vector potential to only one simple integration. The technique is used to obtain exact electromagnetic fields expressions for a thin-wire CLA of arbitrary current distribution and dimension, which is valid everywhere except on the loop. The well known far-fields for the CLA of arbitrary current distribution as well as near and far-fields for uniform current loop and small loop are obtained from the general field expressions presented in this paper as an special cases.