The presented thesis deals with theoretical modeling of the X-ray emission from active galactic nuclei. It studies spectral and polarisation properties of local radiation reflected from the surrounding accretion disc, which is being illuminated by a hot corona above, as well as global observational perspectives at infinity for unobscured radio-quiet sources. Modeling of this kind could then serve for observational fitting of spin of the central supermassive black hole, constraining the accretion disc's or coronal properties, or determining observer's inclination towards the systems. A radiative transfer Monte Carlo simulation code STOKES [Goosmann and Gaskell, 2007, Marin et al., 2012, 2015, Marin, 2018] is used for local computations. Its performance is compared to results of other attempts already existing in literature and analytical approximations. The local scheme is discussed mostly in terms of emergent polarisation that has been for the first time simulated for these types of objects with high accuracy. Integration over the accretion disc and superposition with the primary radiation in the so-called lamp-post or extended coronal model, including all general relativistic effects in the vicinity of the central supermassive black hole, is then performed on the basis of already existing routine KYNLPCR [Dovčiak et al., 2004, 2011]. Such spectral and polarisation results utilizing the new reflection computations are again compared to existing local tables and analytical approaches within the same integral scheme. The analysis is brought to a valuable end by testing the obtained total spectral and polarisation outcome within the observation simulation software IXPEOBSSIM for the first forthcoming X-ray polarimetric mission IXPE (NASA, to be launched in April of 2021), in order to prepare the models for fitting of polarimetric measurements of active galactic nuclei targets and to provide better estimates on observational times needed.