The goal of this research effort is to design and mathematically validate real-time and robust algorithms for autonomous unmanned aerial vehicle (UAV) guidance. These algorithms are intended for use in navigating highly complex, obstacle-laden environments as is the case for trajectory planning in modern industrial UAV applications. Planning for high performance and safety are two critical, yet often opposing, aspects of trajectory planning. In this talk I will present PUMP (Parallel Uncertainty-aware Motion Planning), a multiobjective search framework designed to explore optimal tradeoffs between performance and safety, and also discuss statistical estimation techniques for certifying the safety of computed trajectory plans. A concern at all steps of this research is to design algorithms that may be implemented in a computationally efficient, and in particular parallelized, manner on limited embedded computation hardware.