Conventional plant-model dependent controller design approaches such as gain scheduling work well for simple flight envelope and airframe geometry. For complex flight envelope and airframe the approach results in a costly exercise to obtain a high-fidelity plant model. In this study an adaptive controller design approach is taken for an agile dual aerodynamically-controlled (DAC) missile autopilot. Adaptive controller approach does not require an exhaustive plant model and has the capability of accommodating plant uncertainty and unmodelled dynamics online. A direct model reference adaptive control (MRAC) is investigated with different adaptive rules for the DAC missile. A two time-scale separation dynamic inversion controller with proportional-integral controller was used as the baseline controller of the proposed MRAC controller. The two time-scale separation controller was benchmarked with a gain-scheduled three-loop autopilot. A radial basis function neural network (RBFNN) is used to approximate the unmatched uncertainty of the missile dynamics. Adaption of the uncertainties is done on the fast dynamics controller to ensure fast recovery. The uncertainty of the slow dynamics is handled with a proportional-integral (PI) controller. The following adaptive rules were used with the RBFNN: adaptive loop recovery (ALR), $\sigma-$ modification, $\epsilon-$ modification and optimal control modification (OCM). All the adaptive controllers exhibited better performance over the baseline controller, however the ALR and OCM stood-out in terms of transient performance and actuator deflection demands. A novel normalised optimal control modification rule with co-variance adjustment was also investigated. Normalisation eliminates effect of basis-function amplitudes on the adaption rate and co-variance adjustment eliminates the possibility of persistent learning by adjusting initial set high adaption gains to a lower value with time. The results indicated that normalisation and co-variance adjustment had no detrimental effect on the overall performance of the adaptive controller. It was further observed that the estimated uncertainty by RBFNN did not match the known unmodelled dynamics due to the fact that adaptive controller aims to minimise the tracking error between the reference model and plant irrespective of uncertainty estimation convergence. A homing loop was closed around the adaptive autopilot with a nine-state Kalman filter for target tracking and state estimation; and an augmented proportional navigation rule for collision course trajectory control. Performance envelope of the DAC missile with adaptive autopilot was investigated against a constant speed target, a weaving and constant manoeuvre target. The DAC missile controlled by the normalised OCM update rule with co-variance adjustment autopilot illustrated better performance over the baseline controller and a tail-fin controlled missile for all target engagement scenarios.