Abstract: This talk consists of two interactive parts. First, we will pay an attention to optimized operator splitting strategies, such as the non-exponential ADI and exponential LOD methods, and explore their modernizations. Then we will focus at interesting issues involving the constructions and analysis of highly-effective and highly-efficient finite difference approximations of singular partial differential equations which are crucial to rocket engine designs. The quenching phenomenon will be revealed. Adaptive splitting approaches will then be introduced. Mathematical analysis on solution positivity, monotonicity and stability will be discussed. We will also present the latest ideas on moving mesh strategies which can be extended for solving many multiphysics equations with blow-up singularities from biomathematics, oil pipeline decay detections, cancer treatments, and laser-materials interactions. Potentials of collaborative investigations will be desirable.