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DEVELOPMENT REVIEW AND TECHNICAL CHALLENGES OF LAUNCH VEHICLE

Abstract

Following six decades of development, the technology of launch vehicles has progressed with respect to the dual action of demand traction and technical promotion, providing invaluable high-tech services for society. Currently, the development of launch vehicles is progressing with respect to stronger capability, higher reliability, lowering cost, flexibility, and user convenience.The present paper firstly gives a brief review on the development of worldwide launch vehicle technology. According to the distinct characteristics of development, the global development history of the launch vehicle technology can be roughly categorized into four stages: Initial Development Stage (1950s-1970s), Space Shuttle Stage (1970s-1990s), Commercial Service Stage (1990s-2010s) and Comprehensive Performance Improvement Stage (2010s-present). The brief review concludes that: 1) with the continuous development of space technology, the scale of future space missions will become colossal, and the scope of space applications and services will become extensive, besides a rampant commercialization of the space industry, 2) the space industry sill be more integrated with human society, economy, and livelihood of people; and 3) a *Revolution Ear of Space Transportation*, characterized by low-cost and large-scale access to space, is impending. Furthermore, the paper recognizes the technical characteristics and requirements of the Revolution Era of Space Transportation, based on which the reusable technology and intelligent autonomous technology are identified to be primarily developed for the future development of launch vehicle. Especially, the technical state-of-the-art of the reusable technology are summarized and analyzed from two aspects in view of the reusable launch vehicles in the axisymmetric configuration and lifting-body configuration, and meanwhile, the technical state-of-the-art of the autonomous operation technology are summarized and analyzed in terms of propulsion system fault identification mission reconstruction, actuator fault identification control reconstruction, and autonomous operation control technologies. On this basis, the technical challenges for the reusable technology and intelligent autonomous technology are then analyzed to enable future low-cost and large-scale access to space. At last, several practical constructive suggestions are proposed for the future development of launch vehicle technology.