

# Intelligent Flying Vehicles: From 'Ren-Gong' Intelligence to 'Niao-Gong' Intelligence

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## Abstract

The technical challenges of intelligent flying vehicles lie in breaking through the limitations of 'predefined tasks, ideal environments, and deterministic modes'. It embodies the ability to survive, adaptive, and evolution under high dynamic, strong adversarial constraints, as well as in environments with multiple disturbance and uncertainty, achieving the systematic goal of being 'intelligent in the brain, clear-sighted in the eyes, dexterous in the hands, and robust in the body' like a bird. This report introduces the theoretical, technical, and applied research progress made by our team in the core technologies of bionic intelligence in aerospace ("Niao-Gong" Intelligence), including bionic navigation, bionic manipulation, and bionic system evolution. It also looks forward to the development prospects of safe, green, and evolutionary bionic intelligence systems in the low-altitude industry.



**Lei Guo**, Academician of the Chinese Academy of Sciences and Chief Professor at Beihang University. IEEE/IET Fellow, and Vice Chairman of the China Instrumentation and Control Society. He has long been engaged in research on anti-disturbance control theory and applications of bionic intelligent systems, publishing over 520 SCI/EI papers and obtaining more than 180 authorized invention patents. His theoretical achievements have been successfully applied to multiple major aerospace missions in China. As the first completionist, he has received academic awards such as the Second Prize of National Natural Science, Second Prize of National Technological Invention, First Prize of Ministry of Education Natural Science, First Prize of Ministry of Education Technological Invention, First Prize of National Defense Technological Invention, and the National Innovation Excellence Award. Since 2012, he has successively been elected as a representative of the 14th and 15th Beijing Municipal People's Congress and a representative of the 14th National People's Congress.