

SPACE EXPLORATION SYMPOSIUM (A3)
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HAYABUSA - ON ITS RETURN VOYAGE BACK HOME

Abstract

The Hayabusa spacecraft launched in 2003 is now completing its round trip to a near Earth asteroid Itokawa, to which it accessed in 2005. Hayabusa suffered from a fuel leak and eruption incidents after its successful descent, touch-down and lift-off at the end of November in 2005. It was lost due to another fuel gas eruption at the beginning of December. Through the hiatus of communication for seven weeks, the communication with Hayabusa was restored and had been refurbished for almost one year until early 2007. Hayabusa lost two reaction wheels among three aboard, and the chemical propulsion is not available owing to the fuel leak incident mentioned above. Besides, the battery aboard is dead, since Hayabusa lost attitude completely during the tumbling motion owing to the incidents. The only means left for Hayabusa are the ion engines and xenon gas reserved for them as well as a single reaction wheel. Hayabusa project team devised the use of xenon gas for a cold gas propulsion, and also developed the new attitude control strategy taking the advantage of solar radiation pressure. It poised the attitude drift motion synchronized with the revolution around the Sun to track the Sun for solar power availability by utilizing disturbance torque applied owing to the pressure. And Hayabusa successfully performed its first half of the ion engines propulsion period in 2007. The spacecraft passed its second solar conjunction in 2008, and started the second half of the ion engines burn from this February, will continue it by next February for almost one year. Hayabusa is currently finishing its last propulsion toward the Earth, and schedules to reenter into the atmosphere and will land in middle of Australia in June of 2010. This paper will report how the Hayabusa spacecraft operation has been performed having coped with many difficulties. Especially the paper focused the subtle attitude control strategy newly introduced during the second half of propulsion period. In April to June of this year, the spacecraft was near the aphelion point of around 1.6 AU from the Sun, at the same time at the farthest point, 2.6 AU, from the Earth, and suffered from the doubled austerity in terms of power and communication, since the prescribed ion engines acceleration restricts the spacecraft attitude very rigorously, while the spacecraft was under significantly serious conditions with not enough attitude control capability. The paper summarizes and focuses the special operation history and status.