The Estimation and Correction of Sensor Bias Error in the Inertial Navigation

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ABSTRACT
Japan Agency for Marine-Earth Science and Technology (JAMSTEC) developed a cruising Autonomous Underwater Vehicle (AUV) Urashima. And it achieved 3,518 meters diving in 2001 and 317 kilometers continuous cruise in 2005. These results are a world record. And it is now used to survey the seafloor and understand the seafloor topography and its subsurface construction on wide range. Based on the development, JAMSTEC plans to develop a new AUV which has a decuple continuous cruise capability as compared with Urashima. But to do that, there are various technical problems. One of them is the performance improvement of a navigation system. So we study a method to improve the position accuracy of an Inertial Navigation System (INS), and have proposed the method which applies the rotational motion to the INS. And a function, which estimates and correct sensor bias error of the INS, was installed into the method. As the result of multiple experiments that the method was applied to a mobile object on a ground, great error reduction effect was confirmed.

KEY WORDS: Inertial navigation system; AUV; position error; bias Error; drift error, position accuracy; error reduction; rotational motion.

INTRODUCTION
Urashima was begun to develop from 1997 in order to make use of the solutions of various problems such as a global warming, climate changes, earthquakes, volcanic activities and so on [Aoki,T, 2008]. Therefore its missions are to sample seawater in various water area and depth area, measure many kinds of seawater characteristic in real time, observe the seafloor topography and its subsurface construction. And in some instances, it takes photos and movies of the seafloor continuously. Some performance tests of Urashima in a dock were given by 1999. And many sea trials were carried out by 2004 from 2000. In August 2001, Urashima could dive to 3,518 meters, and in February 2005, it achieved 317 kilometers cruise autonomously. And now, it is used for various types of the oceanographic investigation. Fig. 1 shows its appearance in a sea trial. Urashima can be equipped with two types of power supply system; a lithium-ion rechargeable battery and a fuel cell. And it can cruise continuously for about 30 hours with the lithium-ion rechargeable battery and 60 hours with the fuel cell. In fact, it can