Attachment of Probe for Whale Ecology Observation Satellite System

Tomonao Hayashi*

Abstract

Ecology of many species of whales are not known because of their wide scope of activities. We are building a new system to reveal their migration pattern and living style in the sea. This system is composed of three segments: a dedicated small satellite in a polar orbit of 1000km high, probes attached to many whales in various oceanic regions, and a ground station for tracking, telemetry and command of the satellite.

In each probe a GPS receiver for obtaining the position on the sea surface, and several sensors (pressure, temperature, geomagnetic field and acoustic signal) to detect the environment under the sea are installed. When the whale surfaces these data are sent by UHF band telemetry transmitter to the satellite. The satellite stores the data in a memory after the reception. When the satellite enters in the visible range of the ground station, it sends out a command signal in VHF band, and the stored data in the satellite are transmitted to the ground station in L-band telemetry. The electric power needed for the probe operation will be generated by utilizing the motion of whale, in which AGS system developed by Seiko-Epson Co. for a wristwatch will be applied. Ecological data of whales with individual identification code will be retrieved on the ground. This system is in a process of construction in the Chiba Institute of Technology, expecting the launch of the satellite in 1998-1999.

To realize this system attachment of probes to whales is indispensable. Based on fundamental studies on the attachment, application of a small harpoon shot by an airgun is most promising. To achieve a long term (1-2years) observation, attachment to a living body should be as gentle as possile. To attain tight fixing of the probe a set of barb plane strips made of Ti-Ni shape memory alloy is attached at the top of the harpoon, whose phase transition temperature is chosen to be 30℃, and the shape in the higher temperature is so designed as to be a quarter circle, by which the pressure of the barb against the fascia is reduced and this fact will be effective to avoid the necrosis. Usage of a kind of medicine to avoid infection, and a proper surface treatment of the harpoon material for improving the affinity with living tissues are also considered. Since the thermal time response of the barb is very important for defining the attachment procedure, the thermal time constant of barb plate is calculated based on the configuration under design, and a practical operational scheme is proposed.