Research on Creating Function of New Lightweight Core Structure and Its Forming Method by Fusion of Computational Mechanics and Origami Engineering

Ichiro HAGIWARA

(Tokyo Institute of Technology, Graduate School of Science and Engineering, Professor)

【Outline of survey】

Lightweight core structure with high stiffness and strength must be more and more important because of resource saving. The honeycomb core is said the alias name of core structures without substitute until now despite that it is weak against heat ,week shear force and expensive ,furthermore it is difficult to be curved for shell structure. In July 2007, the Nature magazine issued the Dia-Core as a great possibility that it creates industrial applications of Japanese origami, that Nojima, the co-researcher, discovered using the origami engineering and the theory of space filling. It is necessary to both of the optimization of functions and the establishment for forming method in low price aided by computational mechanics in order that the origami engineering with high possibility applies to the industrial field certainly. The Dia-Core has been shown to be more excellent from comprehensive standpoint than honeycomb, by Nojima's and Hagiwara's researches on the strength and the stiffness, and the core was gotten the news on Japan Journal and the newspapers. Nojima has also invented many types of the original core structures with space filling type of regular polyhedron, quasi-regular polyhedron or skew polyhedron, these are quite different from the existing prismatic core model. In this research, we will establish the method for forming the Dia-Core in low price and invent to the functions of heat insulation, sound absorption and insulation, and geometry pattern designs interweaving light and shadows. In the same time, we are going to develop these forming methods.

【Expected results】

The structure of stable Dia-Core can make to destabilize by handling separation, truncation or cutout for the origami pattern and extend to deflation/deploy models like a polyhedron, a dome or a sponge type, unknown type cores will be invented by them. With aiding computational mechanics, we will develop the optimum forming methods to manufacture the best core with lightweight, high stiffness, functions of deflation/deploy, sound absorption-isolation, heat isolation and other functions. By the development, basic investigation for wide-ranging industrial applications will be progressed space structures like a solar sail, medical products like catheter, stent and artificial muscle, building and railcar floor structures, heat shield building walls, sound proof walls to prevent noise pollution and other applications. And the origami engineering triggered by Japan is recognized as valuable things to the fundamental to environmental conservation by reduction of materials, nano-technology and medical treatment.

【References by the principal investigator】

・(1) Z. Wu, I. Hagiwara and X.tao, Optimization of crush characteristics of the cylindrical origami structure, Int. Vehicle Design, Vol.43, Nos.1-4(2007), pp 66-81.
・(2) Hagiwara Ichiro, From Origami to Origamics, The Japan Journal July 2008 ,Science,pp22-25.

【Term of project】 FY2008－2012	【Budget allocation】 151,700,000 yen (direct cost)

【Homepage address】 http://www.mech.titech.ac.jp/~h-souzou/