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Development of a transformation robot having inflatable frames with film-surfaced bellows

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Recently, we frequently suffer from natural disasters like the Iranian earthquake, the Niigata-chuetsu earthquake and the tidal wave disaster caused by the Sumatran coast earthquake. It makes to several hundred thousand victims instantaneously. Moreover, in 2001, the Newyork city in United States of America's people suffer from an artificial city type disaster caused by the September eleven terrorist attacks. And, the probability of the Southern sea earthquake and the southeast sea earthquake occur on the scale of magnitude 7 to 8 be said 40 to 50 percent, at the large Pacific Ocean coast area put from Tokyo in Japan to West Japan within 30 years in the future. And it is assumed that those who die the forecast in that case are 7400 people. There is a possibility that the forecast value swells up to these several times. So the establishment of disaster prevention and the life rescue system to such a city type disaster are very aspired.

In Japan, it begins to focus attention on the life rescue system to the city type disaster, since suffered the Hanshin-Awaji (Kobe) Earthquake. Now, Centering on the NPO international rescue system research mechanism (inauguration in April, 2002) go about the research on the life rescue system. In the one expected most in these researches, there is "Life rescue system using the robot". Because the robot researchers' in the United States organizing the team with the rescue team, and doing the life serch

activity using by the mobile robot, and found two or more remains of the victims by 9.11 from under the rubble. This case was drafted the robot for the first time in an actual rescue site officially. It was not able to find only one survivor. But this event make to be known the utility of rescue operation that man had cooperated with the robot on a worldwide basis.

Afterwards, the research on the rescue robot starts rapidly, and became a part of Ministry of Education's urban renaissance projects "Metropolitan great earthquake reduction making special project (Calling the DaiDaiToku project)" is a movement in the air group in Japan in 2002. The development of the technology for the disaster because of dividing into six groups named an environmental modeling group, the movement mechanism group, the information gathering group, the Sensing group, and the human-interface group, and the use of a robot and the related technology is performed.

In the situation revolving around us, we examined the application of the inflatable structure to the mobile robot. The inflatable structure are one kind of deployable structure, which filling on the gas such as air in the film and the expansion like the balloon. The inflatable structure has the features that the volume before develops is very small compared with the after develops. So this structure has the high expansion and contraction rate. If this inflatable structure applied to the frames of the mobile robot, the frames can expand and contract. So it can be achieved having to the high expansion and contraction rate robots. As a result, greatly reducing the storage capacity of the mobile robot before develops becomes possible, and the storage efficiency of the robot can be improved. This means achieving the system that storing a lot of robots in the decided capacity when it is necessary to transport a lot of robots to the stricken area like the rescue robot, and operates as a robot becomes possible by the frame's expanding in the stricken area.

Then, this paper was shown development of a mobile robot having possible deflation inflatable actuator (FSB:Film Surfaced Bellows and below FSB) which had never been able to deflate to before develop shape. And shown to have achieved the mobile robot that was able to expand and contract from 1000mm in the total length to 770mm by applying inflatable actuator.

Moreover, if a mobile robot using for a rescue robot is need the system of running in the punishing road and chlimbing over obstacles like rubbles. Then, this paper proposed the chlimbing over obstacles mechanism that became possible achievement by combining the air jacks and extention rails having FSB. This mechanism achieves getting over obstacles sliding back and forth the center of garavity position on the robot. The chlimbing over obstacles system is used for the obstacle where it cannot run the moving mechanism of thmselves. The research is reported using the crawler arm can be driven up and down, and throw the tezar so far and takeing up using the winch. This mobile robot used FSB which actuated by air-pressure so it can be achieved mounting airjack under the robot's chasis. This airjack achieves a big contraction percentage by applying FSB compared with development with a feed screw or the using oil-pressure and air-pressure cylinder. In this paper was shown that the obstacle of 170mm in height was chlimbed over by mounting the chlimbing over obstacles mechanism using the airjack and the extention rail where FSB had been applied on the mobile robot, experiment of chlimbing over the obstacles. And, this paper were shown effectiveness and the realizability of this chlimbing over obstacles mechanism.