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# DEVELOPMENT OF EFFICIENT OPTIMIZATION AND APPLICATION TO PRESSURE VESSEL OF FUEL-CELL VEHICLES

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In the development of fuel-cell vehicles, a pressure vessel for fuel is important theme. A high-pressure vessel is required for storing a lot of fuel. We considered fuel cells reinforced by wires shown by Figure 1.

Fig. 1. Fuel cell with wires

The number of wires and its position are design parameters. At first we used the genetic algorithm. The figure 2 shows the mesh for optimization using the genetic algorithm.

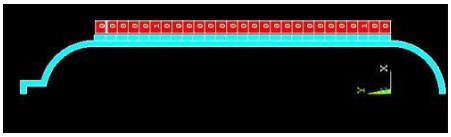

Fig. 2 Mesh for the genetic algorithm

In this figure, upper elements present wires. Figure 3 shows the results of the genetic algorithm. The vertical axis indicates maximum stress and the horizontal axis indicates the number of wires.

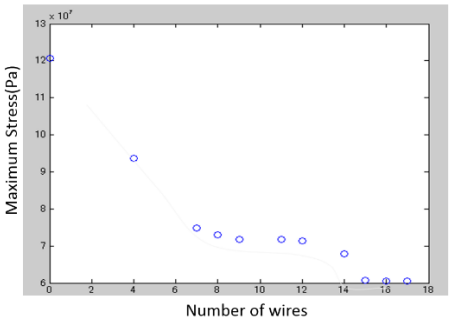


Fig. 3 Results of the genetic algorithm

This results show the maximum stress is almost the same for 6 wires or more and the distance

between wires is almost same.

One of the faults of the genetic algorithm is that the genetic algorithm requires a lot of calculation. Therefore we tried to reduce the calculation considering the application of efficient global optimization, or EGO. EGO[1)] is famous for the technique for optimization using small number of sampling points. We decided the number of wires is four for simplifying the test of EGO. The test of EGO showed that the search for the optimum point was slow because the response surface for optimization is not smooth in this case. Then we considered the improvement of efficiency of EGO. We used the a priori information that the uniform arrangement is good for reinforcing fuel cells. In this case the a priori information is defined as the inverse of standard deviation of distance between wires.

Table 1 shows the example of comparison of results. The used solver is ANSYS.

Table 1. The number of calculations times using ANSYS

| | Initial number of data points | | | |
|---|---|---|---|---|
| | 10 | 15 | 20 | 25 |
| EGO without a priori information | 19 | 16 | 9 | 6 |
| EGO with a priori information | 3 | 4 | 3 | 3 |

This table shows that the number of calculation times with a priori information is much smaller than without priori information.

## CONCLUSION

We developed the efficient optimization technique using EGO with a priori information and applied this method to Pressure Vessel of Fuel-Cell Vehicles. The numerical result shows the validity of this method.

## REFERENCES

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