Concepts and applications of multi-directional finite difference method

in memory of Prof. Kunio Kuwahara

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Professor Kuwahara developed multi-directional finite difference method around 1990. Previously, he had long been considering some possibilities of construction of a more natural finite difference method. Finally, he arrived at a new strategy, which was simple but which had nevertheless been difficult to strike upon:

i. If one has a finite difference mesh as presented in Fig. 1.
ii. Another mesh system can be considered by $\pi/4$ rotation, as shown in Fig. 2.
iii. The results from both mesh systems can be mixed in appropriate weights

The weights of both mesh systems were determined to render the leading term of the truncation error as invariant for rotation. If one had a CFD code for a generalized coordinate system, then necessary code modifications would be straightforward, the increase of computational time would be minimal and the flow computation stability increases greatly.

After establishing the multi-directional finite difference method, Prof. Kuwahara utilized it for various applications and various new techniques—such as the multi-grid approach—in quite an exciting manner, as we all know.

References