Research Travel Report

Kwanghyuk Park[1]
Pohang University of Science and Technology, Korea

1 Research Theme

The main purpose of this research trip was to explore the possibility of applying weighted essentially non-oscillatory (WENO) schemes to the viscoelastic systems. Viscoelastic models are widely used to describe materials and flows that exhibit both viscous and elastic behavior, and they appear in various engineering and industrial applications. However, compared to classical hyperbolic conservation laws, viscoelastic systems usually contain additional stress evolution equations and more complex coupling between physical variables, which makes numerical simulation more challenging.

WENO schemes have been successfully used for solving hyperbolic conservation laws with discontinuities, but their application to viscoelastic systems has not been fully studied. Therefore, this research trip focused on understanding the structure of viscoelastic equations and investigating the feasibility of extending WENO-based numerical methods to such systems.

2 Result from Research Travel

During the research visit, I first focused on understanding how viscoelastic governing equations are constructed. In particular, we discussed how the stress equations are coupled with the momentum equations and how the relations are incorporated into the system. This helped me understand the mathematical structure and numerical characteristics of viscoelastic models, which is an important step before applying WENO schemes.

In addition, thanks to Prof. Tagami, I can get to know how finite element methods have been applied to viscoelastic systems in existing research. By studying stabilized finite element formulations, I was able to understand how numerical stability is maintained when solving viscoelastic systems. In particular, discussions with the professor on stabilization terms provided insight into how numerical methods are designed to control instabilities in complex coupled systems.

Through these activities, I gained a clearer understanding of the current research approaches for viscoelastic numerical simulation and identified key considerations that need to be addressed when applying high-order numerical methods such as WENO schemes.

3 Future Research

Based on the outcomes of this research trip, future research will focus on developing WENO-based numerical methods for viscoelastic systems. In addition, discussions during the research visit suggested a new research direction related to stabilized finite element methods. In particular, determining appropriate coefficients for stabilization terms was identified as an important problem,

[1]pkh0219@postech.ac.kr

which may extend to a new research topic. By continuing research in these directions, this work is expected to contribute to the development of reliable numerical methods for viscoelastic systems.