6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11-15 June 2018, Glasgow, UK

Step-size control for cyclic problems with strongly varying loads

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Keywords: *time-adaptive schemes, cyclic loading, biomechanics, plasticity*

In nature, there exists many processes, which are periodic, for example, pressure cycles in human arteries, components subjected to cyclic loading in machines etc. Using constant time-steps for cyclic processes is computationally expensive. For these purposes, generally, time-adaptive schemes according to [1] are used. However, in the case of complicated loading processes, like pressure cycles in an artery, computations are very expensive due to the high number of step-size rejections.

In this presentation, a new history-based scheme is proposed. The history of the process is also used to estimate the next step-size. Using this scheme, around 20% of the computational time can be saved. This is attributed to the large number of reduction in the rejected number of time steps. As a first example, complicated pressure cycles are applied to a human artery model describing the active response of an artery due to diffusion processes of chemicals. The numerical scheme in [2] is followed and diagonally implicit Runga-Kutta method is applied. A comparison between the already existing time adaptive scheme and the newly proposed scheme is demonstrated. Another simple example using cyclic plasticity model is also shown to demonstrate advantage of the proposed scheme.

REFERENCES

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