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Determination of asymptotic state of a structure using the Proper Generalized Decomposition

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Structures under cyclic loading can have three asymptotic states. The first one is purely elastic and named elastic shakedown, the second one is stabilized but partially plastic and named plastic shakedown, the last one is the plastic ratcheting. In this last state, a new strain occurs at each loading cycle. This phenomenon is due to material comportment itself or some composed loadings and can lead to crack. As it lead to more strain with each cycle structures can fail at any time during the life time span. Today structures become too oversized so industries need to be able to determine a more accurate asymptotic state and in particular strains due to plastic ratcheting effects [1].

Since the asymptotic state is very difficult to obtain mathematically, its determination needs computation of a lot of loading cycles (often hundreds and even thousands of cycles). The cost of this calculation is then too high and the computation becomes impossible. In order to get the asymptotic state, various methods have been used and the use of Reduced Order Model methods seems to be the most promising way to deal with these problems.

The Proper Generalized Decomposition (PGD) is one of them. It's an *a priori* method and this involves no computation of a reference base [1][2]. The base is enriched on the fly and has just enough dimensions. This study extends the use of the PGD to nonlinear plastic problems, and presents its application to determine the asymptotic state of structures with existing behaviour laws including plastic ratcheting phenomenon by separation of time and space.

REFERENCES

[1] J.L.Chaboche. A review of some plasticity and viscoplasticity constitutive theories, International Journal of Plasticity, 24(2008) 1642-1693.

[2] F.Chinesta, A.Ammar, A.Leygue, R.Keuning An overview of the proper generalized decomposition with applications in computational rheology, Journal of Non-Newtonian Fluid Mechanics, 166(2011) 578-592.