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Object-Oriented Fortran to model Non-Linear Vibration

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Object-Oriented programming has demonstrated numerous advantages for many applications in the computational science community [1][2]. The Object-Oriented programming generic concepts allow scientists to develop various numerical tools portable across different Computer/cluster architectures [2]. Moreover, adopting an Object-Oriented approach enables an easier way for developer to maintain the code. For instance, adding and removing features will have a minimum impact on the code.

This work covers the ongoing efforts in the refactoring project of FORSE [3]. Originally written in Fortran 77/90, the refactored version is modernized to comply with Fortran 2003/2008 standards [4]. FORSE is dedicated for the analysis of non-linear vibrations of large mechanical systems using a multi-harmonic balancing method. The multi-harmonic balance method consists on solving mechanical system exhibiting a periodic behaviour. The solution of the mechanical system is expanded into a Fourier Series with respect to a scalar parameter. The obtained non-linear system is then coupled with a continuation technique.

After a brief description of the multi-harmonic balance method, an overall description of the adopted architecture of FORSE with a special emphasises on the most important created classes is presented. It is of most importance to highlight their impact on obtaining a generic and flexible solver capable of having new features added instantly. A comparison between the pre/post-refactoring versions of FORSE draws a special attention to the impact of the refactoring process on the computing time, results quality, clearness of the code and other aspects. It is followed by numerical study confronting the different implemented non-linear solvers and continuation techniques .

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