Abaqus user subroutines for 3D topology optimization of continuous fiber-reinforced structures

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The method to optimize a topology of 3D continuous fiber-reinforced additively manufactured structures is discussed. The proposed method makes it possible to simultaneously search for density distribution and local reinforcement layup in 3D composite structures of transversely isotropic materials. The approach uses a dynamical systems method to find density distribution, combined with the method for rotation of reinforcement direction to align it in the direction of principal stresses with local minimum compliance. The algorithm is implemented as a built-in material model within Abaqus finite element suite. Both the optimal material density distribution and the distribution of fiber orientation vector are determined for three structural elements used as benchmarks: the bending of simply supported 2D beam under central point load, the loading of 3D cube by vertical load, and the bending of 3D cantilever beam.

A more detailed description of the problem is given in the article

Safonov, A.A. [3D topology optimization of continuous fiber-reinforced structures via natural evolution method](https://www.sciencedirect.com/science/article/pii/S0263822318305609). **Composite Structures** 2019, 215, 289–297, doi:10.1016/j.compstruct.2019.02.063.

The preprint of this article is in the folder.

For information about Abaqus user subroutines, see [Abaqus User Subroutines Reference Guide](http://abaqus-pc:2080/v6.13/books/sub/default.htm) and [“User subroutines: overview,” Section of the Abaqus Analysis User's Guide](http://abaqus-pc:2080/v6.13/books/usb/usb-link.htm#usb-anl-asubroutineover).

Software: Abaqus/CAE 6.14-4