Analytical solution to the 1D Lemaitre's isotropic damage model and plane stress projected implicit integration procedure - DTU Orbit (24/12/2018)

**Analytical solution to the 1D Lemaitre's isotropic damage model and plane stress projected implicit integration procedure**

In the present paper, for the first time in literature an exact analytical solution to Lemaitre's isotropic damage model is developed for the special case of uniaxial tensile testing. This is achieved by taking advantage of a convenient formulation of the isotropic hardening function, which allows obtaining an integral relationship between total strain and effective stress. By means of the generalized binomial theorem, an expression in terms of infinite series is subsequently derived. The solution is found to simplify considerably existing techniques for material parameters identification based on optimization, as all issues associated with classical numerical solution procedures of the constitutive equations are eliminated. In addition, an implicit implementation of the plane stress projected version of Lemaitre's model is discussed, showing that the resulting algebraic system can be reduced to a single non-linear equation. The accuracy of the proposed integration scheme is then verified by means of the presented 1D analytical solution. Finally, a closed-form expression for the consistent tangent modulus taking damage evolution into account is given, and its impact on the convergence rate is analyzed.

**General information**

State: Published
Organisations: Department of Mechanical Engineering, Manufacturing Engineering
Contributors: Andriollo, T., Thorborg, J., Hattel, J. H.
Pages: 5759–5774
Publication date: 2016
Peer-reviewed: Yes

**Publication information**

Journal: Applied Mathematical Modelling
Volume: 40
ISSN (Print): 0307-904X
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 2.68 SJR 0.876 SNIP 1.394
Web of Science (2017): Impact factor 2.617
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 3.03 SJR 1.139 SNIP 1.784
Web of Science (2016): Impact factor 2.35
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 2.67 SJR 1.199 SNIP 1.685
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 2.72 SJR 1.143 SNIP 1.9
Web of Science (2014): Impact factor 2.251
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 2.73 SJR 1.074 SNIP 1.974
Web of Science (2013): Impact factor 2.158
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 2.22 SJR 0.889 SNIP 1.811
Web of Science (2012): Impact factor 1.706
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 2.06 SJR 0.844 SNIP 1.548
Web of Science (2011): Impact factor 1.579
ISI indexed (2011): ISI indexed yes