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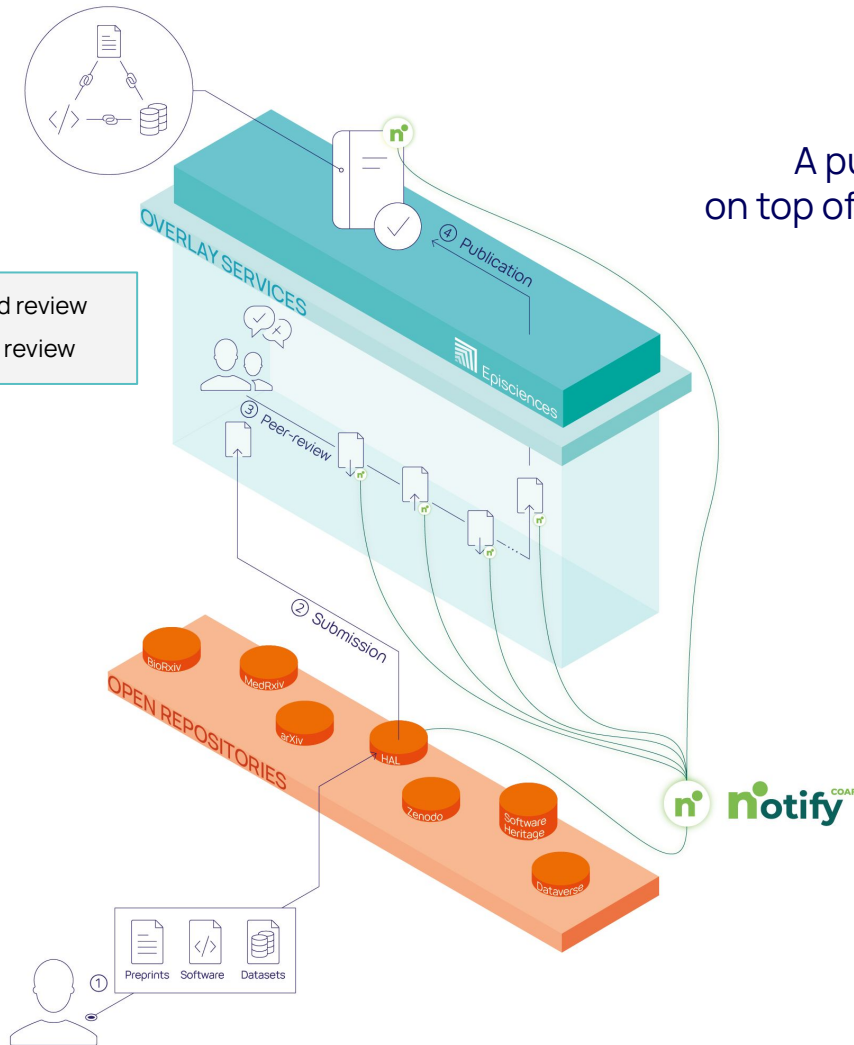
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Stéphane André ; Camille Noël - Solving viscoelastic problems with a Laplace transform approach supplanted by ARX models, suggesting a way to upgrade Finite Element or spectral codes

jtcam:10304 - Journal of Theoretical, Computational and Applied Mechanics, October 10, 2023 - <https://doi.org/10.46298/jtcam.10304>**Solving viscoelastic problems with a Laplace transform approach supplanted by ARX models, suggesting a way to upgrade Finite Element or spectral codes** ArticleAuthors: Stéphane André ¹; Camille Noël ²**1** Laboratoire Énergies et Mécanique Théorique et Appliquée**2** Laboratoire Cogitamus

Finite Element codes used for solving the mechanical equilibrium equations in transient problems associated to (time-dependent) viscoelastic media generally relies on time-discretized versions of the selected constitutive law. Recent concerns about the use of non-integer differential equations to describe viscoelasticity or well-founded ideas based upon the use of a behavior's law directly derived from Dynamic Mechanical Analysis (DMA) experiments in frequency domain, could make the Laplace domain approach particularly attractive if embedded in a time discretized scheme. Based upon the inversion of Laplace transforms, this paper shows that this aim is not only possible but also gives rise to a simple algorithm having good performances in terms of computation times and precision. Such an approach, which fully relies on the Laplace-defined Behavioral Transfer Function (LTBF) can be promoted if it uses AutoRegressive with exogenous input parametric models perfectly substitutable to the real LTBF. They avoid the hitherto prohibitive pitfall of having to store all past data in the computer's memory while maintaining an equal computation precision.

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Keywords: Laplace transform, ARX models, Iterative algorithm, Viscoelasticity, Fractional relaxation kernels, [SPI.MECA.SOLID]Engineering Sciences [physics]/Mechanics [physics.med-ph]/Solid mechanics [physics.class-ph]

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Solving viscoelastic problems with a Laplace transform approach supplanted by ARX models, suggesting a way to upgrade Finite Element or spectral codes Article

 Authors: Stéphane André ¹; Camille Noûs ²

- 1 Laboratoire Énergies et Mécanique Théorique et Appliquée

- 2 Laboratoire Cogitamus

Finite Element codes used for solving the mechanical equilibrium equations in transient problems concerns about the use of non-integer differential equations to describe viscoelasticity or well-founded frequency domain, could make the Laplace domain approach particularly attractive if embedded in a time discretized scheme. Based upon the inversion of Laplace transforms, this paper shows that this aim is not only possible but also gives rise to a simple algorithm having good performances in terms of computation times and precision. AutoRegressive with eXogeneous input parametric models perfectly substitutable to the real LTBF. They avoid the hitherto prohibitive pitfall of having to store all past data in the computer's memory while maintaining an equal computation precision.

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**Journal of Theoretical,
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Solving viscoelastic problems with a Laplace transform approach supplanted by ARX models, suggesting a way to upgrade Finite Element or spectral codes

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Finite Element codes used for solving the mechanical equilibrium equations in transient problems associated to (time-dependent) viscoelastic media generally relies on time-discretized versions of the selected constitutive law. Recent concerns about the use of non-integer differential equations to describe viscoelasticity or well-founded ideas based upon the use of a behavior's law directly derived from Dynamic Mechanical Analysis experiments in frequency domain, could make the Laplace domain approach particularly attractive if embedded in a time discretized scheme. Based upon the inversion of Laplace transforms, this paper shows that this aim is not only possible but also gives rise to a simple algorithm having good performances in terms of computation times and precision. Such an approach, which fully relies on the Laplace-defined Behavior or Transfer Function (LTBF) can be promoted if it uses AutoRegressive with eXogeneous input parametric models perfectly substitutable to the real LTBF. They avoid the hitherto prohibitive pitfall of having to store all past data in the computer's memory while maintaining an equal computation precision.

Keywords: Laplace transform, ARX models, iterative algorithm, viscoelasticity, fractional relaxation kernels











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Tkachuk, A., Krake, T., Gade, J., & Von Scheven, M. (2023). *Matlab Implementation of Efficient Computation of Redundancy Matrices* [dataset]. DaRUS. [10.18419/DARUS-3347](https://doi.org/10.18419/DARUS-3347)

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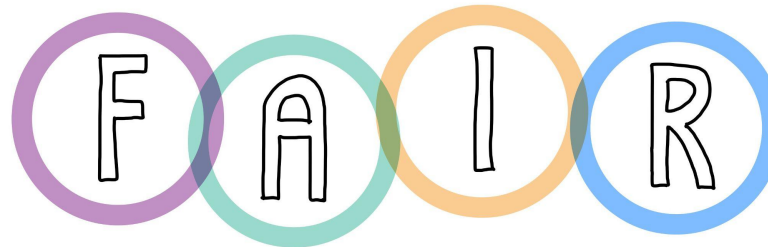
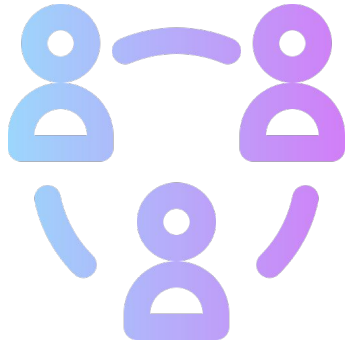
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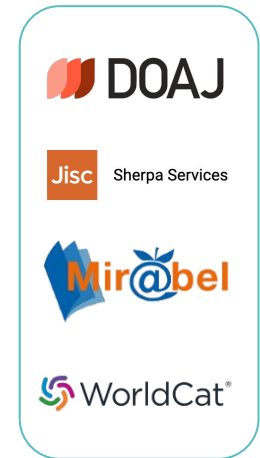
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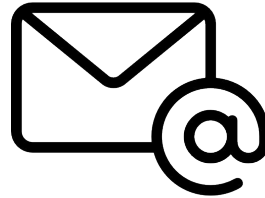
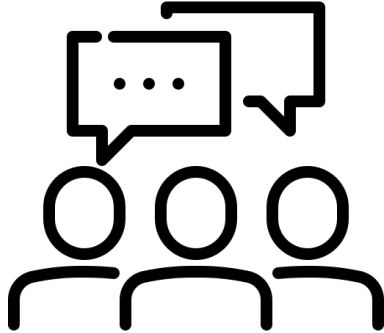


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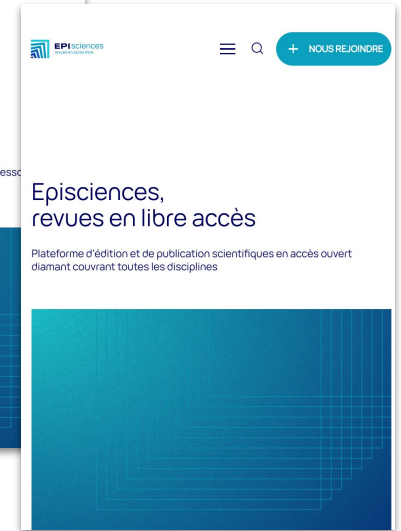
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