



Fellow	<James / Jackaman>
Host Organisation	<NTNU >
Scientific coordinator	<Elena / Celledoni>



## I – SCIENTIFIC ACTIVITY DURING YOUR FELLOWSHIP

During my fellowship I conducted research on geometrically exact beams in line with the interests of the THREAD project. I encountered implementational difficulties here with the multisymplectic implementation, which were caused by the (potentially) degenerate structure of the skew-symmetric operators and a need to enforce additional initial conditions while the problem was in multisymplectic form. In this project we have pivoted to instead focus on the incorporation of symmetries and learning models of geometrically exact beams which respect these symmetries. More successfully, my time as an ERCIM has allowed me to learn about structure-preserving machine learning, which is a core interest of my group at NTNU. So far, we have submitted one paper on this topic.

During the fellowship I applied for (and was awarded) a MSCA postdoctoral fellowship which directly utilises the skills and connections I have developed during my time as an ERCIM postdoctoral fellow,.

## II – PUBLICATION(S) DURING YOUR FELLOWSHIP

**Accepted:** Alex Bihlo, James Jackaman, and Francis Valiquette. Invariant variational schemes for ordinary differential equations. *Studies in Applied Mathematics*, 148(3):991–1020, 2021.

**In review:** James Jackaman and Scott MacLachlan. Preconditioned Krylov solvers for structure-preserving discretisations. *SIAM Journal on Matrix Analysis and Applications* (waiting for second review), 2022.

**Pending revisions:** Elena Celledoni, James Jackaman, Davide Murari, and Brynjulf Owren. Predicting pixel data: Insights from PDEs and finite differences. *IMA Journal of Applied Mathematics* (under revision), 2023.

## III – ATTENDED SEMINARS, WORKHOPS, CONFERENCES

June 2022: Participation in ECMI industrial study group ESGI 156, Alesund, Norway.

*Invited talks:*

- August 2023: ICIAM, Tokyo, Japan: “Geometric numerical integration in neural networks and insights from PDEs”
- June 2023: Simula, Oslo, Norway: “Convolutional neural networks and finite element methods”
- February 2023: MaGIC 2023, Ilsetra, Norway: “On the application of deep learning to regional weather modelling”
- December 2022: HB60 Theoretical and computational aspects of dynamical systems, Trysil, Norway: “Preconditioned iterative methods for structure-preserving discretisations”
- October 2022: CODYSMA-1, Trondheim, Norway: “Lie point symmetry preserving finite element methods”



- October 2022: Defects and Distortions of Layered Complex Fluids, BIRS, Canada: “Finite element modelling of Fréedericksz transition in Smectic C liquid crystals”
- April 2022: First meeting of Applied Geometric Mechanics research network, University of Exeter, UK: “Preconditioned Iterative Methods for Structure-Preserving Discretisations”
- March 2022: MaGIC 2022, Ilsetra, Norway: “Structure preserving finite element discretisations for geometrically exact rods”

Contributed talks:

- June 2023: 29th Biennial Numerical Analysis Conference, Scotland’: “Constraint satisfying iterative methods for structure-preserving discretisations”
- July 2022: SciCADE, Reykjavik, Iceland: “Energy conserving finite element discretisations for multi- symplectic PDEs”
- April 2022: SIAM Copper Mountain conference on iterative methods, Virtual: “Preconditioned iterative methods for structure-preserving discretisations”

## IV – RESEARCH EXCHANGE PROGRAMME (REP)

Attended Simula for one week for a research exchange. Here I gave a presentation, met many relevant people at Simula and entered research discussions with multiple members of the company.