Review to paper 0205

February 12, 2020

The paper is well written and interesting. However, I have some remarks.

1. Concerning Eq. 5, the system can be written in pH form using non-conservative variables but that demands special care. The problem clearly arises for the fact that the Hamiltonian should be defined w.r.t. a *weighted* inner product, where the cross section represent the weight.

   - To obtain a suitable pH formulation you can follow example 5 of [1] and obtain a system as Eq. 28 therein. The skew-symmetric operator $\mathcal{J}_{MH}$ in Eq. 28 of [1] is formally skew-adjoint w.r.t. the weighted L^2 inner product.
   - Or, equivalently, you can rely on the formulation detailed in [2]. In this case the presence of a mass matrix $\mathcal{E} = \mathrm{Diag}(A, A)$, imposes the use of effort function z such that $\delta_\alpha \mathcal{H}_s = \mathcal{E}^* z$, where α is the state variable. The skew-symmetric operator is simply $\mathcal{E}\mathcal{J}_{MH}$.

   In either case, the formulation corresponds to a port-Hamiltonian system with a linear interconnection operator and the gravitational contribution is naturally included. I recommend that you take all this into account and cite the appropriate references.

2. Secondly, the boundary variables appearing in the Stokes-Dirac structure of Proposition 3 and 4 should be related to the physical variables and the boundary conditions of the classical PDE problem. I recommend to clearly state the physical meaning of the boundary variables in each Stokes-Dirac structure and the connection with the classical boundary conditions of problem 2 and 3.

Moreover, in the actual quite complicated formulation that has been developed, I doubt that the application of structure-preserving numerical methods will prove straightforward.

References

[1] Denis Matignon and Thomas Hélie. A class of damping models preserving eigenspaces for linear conservative port-Hamiltonian systems. *European Journal of Control*, 19(6):486 – 494, 2013.

[2] Volker Mehrmann and Riccardo Morandin. Structure-preserving discretization for port-Hamiltonian descriptor systems. In *Proceedings of the 59th IEEE Conference on Decision and Control*, pages 6663 – 6868, 2019.