Next-generation HPC models for future Rotorcraft applications
MS 51 Enabling industrial applications towards exascale computing

T. Benacchio[1], N. Sanguini[1], F. Cipolletta[2], D. Malacrida[2], F. Rondina[2], A. Sciarappa[2], I. Spisso[2] and L. Capone[2]

[1] Leonardo Labs, Future Rotorcraft Technologies, Leonardo S.p.a., Via G. Agusta 520, Samarate (VA), Italy {tommaso.benacchio.ext, nicoletta.sanguini.ext}@leonardocompany.com

[2] Leonardo Labs, Leonardo S.p.a.,Via Pieragostini, 80, Genoa, Italy
{federico.cipolletta.ext, daniele.malacrida.ext, antonio.sciarappa.ext, ivan.spisso.ext, luigi.capone}@leonardocompany.com

Key Words: Fluid dynamics, Computational Mechanics, Exascale Computing, Engineering, Industrial Applications.

Rotorcraft technologies pose great scientific and industrial challenges for numerical computing. As available computational resources approach the exascale, finer scales and therefore more accurate simulations of Engineering test cases become accessible. However, shifting legacy workflows and optimizing parallel efficiency and scalability of existing software on new hardware is often demanding.

This talk will highlight ongoing research and development activities at Leonardo Labs and the Leonardo Helicopters division in porting Engineering applications to the newly installed Da Vinci-1 supercomputing and cloud facilities, with specific reference to optimization of numerical methods in massively parallel simulations. Computational aerodynamics and structural mechanics tests will highlight native and customized GPU performance of both currently employed commercial packages (such as Fluent®, StarCCM+®, ABAQUS®) and innovative open-source scientific computing frameworks (such as PyFR [1,2]).

Advantages and challenges will be discussed in relation to scientific and economic benefits of moving to next-generation hardware in an industrial context, also with a view to future partnerships with EU HPC Centres of Excellence. The activities are part of a broader industrial Digital Innovation strategy centred on Digital Twins combining high-fidelity, highly scalable numerical simulations with data-driven AI models.

REFERENCES

[1] Park, J. S., Witherden, F. D., & Vincent, P. E. (2017). High-order implicit large-eddy simulations of flow over a NACA0021 aerofoil. *AIAA Journal*, *55*(7), 2186-2197.

[2] Witherden, F. D., Farrington, A. M., & Vincent, P. E. (2014). PyFR: An open source framework for solving advection–diffusion type problems on streaming architectures using the flux reconstruction approach. *Computer Physics Communications*, *185*(11), 3028-3040.