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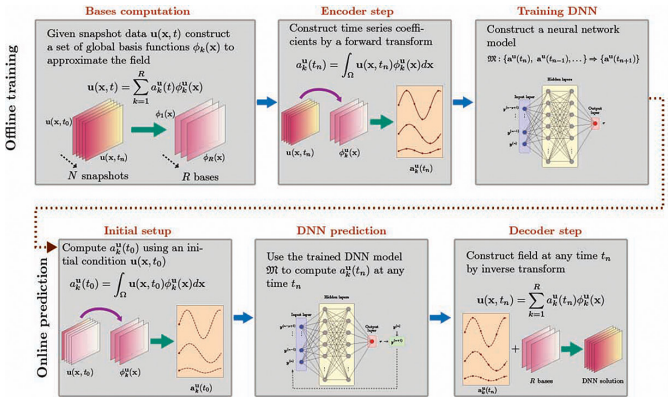
Limitations can be surpassed as deep learning is used to develop nonintrusive methods of modeling fluid flows.



Reduced order models are used to solve problems in diverse areas such as flow control, data assimilation, parameter estimation and uncertainty quantification. One of the primary applications of reduced order modelling is in optimal flow control, which is usually limited by wide ranges of spatial and temporal scales and often requires an intrusive approach. This means the exact form of underlying equations is required.

San et al. bypassed some of these limitations by developing a deep learning enabler for nonintrusive reduced order modeling of fluid flows. Their data-driven approach does not need any prior information about underlying governing equations required for generating the reduced order model.

“Thanks to the abstractions in open source software packages, simulation and data analytic tools, and advanced computing platforms, the interactions between domain specific scientists and data scientists have increased exponentially in recent times,” San said.

The authors demonstrated their approach to a diverse set of fluid flow problems with success. Their method is portable and applicable to experimental data, where equations are not well established or have uncertainties regarding their parameters.

“Interactive coupling between first principles and data-driven tools will be crucial, since both techniques benefit from each other synergistically. We might witness novel approaches or even paradigm shifts in the near future to tackle some of the fundamental challenges not addressed by evolutionary segregated modeling practices,” San said.

The authors intend to apply this approach to more realistic problems involving complex geometries, so the framework proposed can serve as one of the key enablers for building digital twins.

Source: “A deep learning enabler for nonintrusive reduced order modeling of fluid flows,” by S. Pawar, S. M. Rahman, H. Vaddireddy, O. San, A. Rasheed, and P. Vedula, *Physics of Fluids* (2019). The article can be accessed at https://doi.org/10.1063/1.5113494.