Physics of Data. Part XVI

Physics of Data. Part XVI | Alfonso R. Reyes

Why such a small group of scientists is so unique as to transforming machine learning with laws of physics?

From the attached post, please take a look at the slides:

“Often, I find people surprised when
I remark about such connections.
To this end, below are a few slides.
These show the tip of the iceberg.”

AR. Easy to explain. Not everybody is kin of differential equations. Very few careers really go further in developing and applying differential equations. In engineering, differential equations is the seventh or eighth math course, and you want quickly get over with. The only way that you could really explore and gain understanding of the advanced use of differential equations, Ordinary (ODE), and Partial (PDE), is to develop a career in physics, mathematical physics, or a postdoc in math oriented to physics. The rest of us, engineers, are mainly observers.

That explains why the only ones advancing differential equations commingling them with machine learning algorithms such as Physics Informed Neural Networks, Neural Operators, and so many others, are scientists in academia, or in the national US laboratories, or advanced research facilities, the ones working in fusion, lasers, ignition, testing and simulating nuclear reactions. The literature, now in the order of two thousands, confirm it.

What is amazing is this is the only bunch in the world that are really progressing machine learning in its more effective and accurate way because a physicist is able to build up a differential equation out of observing state variables. That is not part of the skill set of data scientists or machine learning engineers, including people working in language models or LLM, or what is commonly called AI.

What is particularly interesting is that when you combine laws of physics and machine learning you don’t need anymore Big Data, the term that was introduced by the facebooks, twitters, googles, or companies working with mobile data. The new world of scientific machine learning is one of Small Data. Why? Because if the scientist is able to produce a differential equation out of the experimental data, you end up not needing huge amounts of data anymore, except for calibrations.

It will take a generation - I doubt five or ten years-, to get to a phase where data science and machine learning is fully based in physics and differential equations. Pretty much the same revolution that brought us linear algebra, arrays, matrices, tensors, statistics, probability, Bayes, loss functions, cloud computing to be today front and center.

Alfonso R. Reyes • You
VP Artificial Intelligence Engineering - Energy Division
3mo • Edited •

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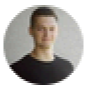
#ai #digitalTransformation #petroleumEngineering #spe #PhysicsOfD



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Applied Math PhD | Building Optimization Algorithms | Educator
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Differential equations are surprisingly useful in optimization. Their discretizations yield famous algorithms. Why care? 👇 ...more