Research for "Does simulating Newtonian Physics mean we finally understand it?"

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Introduction

This paper serves as the research for my report on "Does simulating Newtonian Physics mean we finally understand it?", containing:

1. An overview on the workings of Newtonian Physics;
2. Use-cases of Newtonian Physics;
3. The advantages/benefits of simulating Newtonian Physics;
4. A discussion on whether we could "*master*" Newtonian Physics towards the future.

In each section, it will contain both a reference to a relevant source and a brief summary about why said reference would be useful in answering that sub-topic.

1 Overview on Newtonian Physics

[1.] ("Classical Mechanics". With a comment. by Jon Humberston. In: [2009]. URL: https://www.ucl.ac.uk/~zcapd49/phas1247coursenotes.pdf. accessed: 27/3/25)

Course notes regarding the fundamental parts of what classical mechanics are, the associated sub-topics and related fundamental equations/diagrams.

[2.] (Juha Saatsi. "On Explanations from Geometry of Motion". In: *The British Journal for the Philosophy of Science* 69.1 [2015]. DOI: https://dx.doi.org/10.1093/bjps/axw007. accessed: 25/3/25)

This paper explores in-depth on how kinematics and dynamics work in conjunction with one another, the applications and the purpose of the "geometry of motion" within a wider scope.

[3.] (Donald T. Greenwood. *Classical Dynamics*. Dover Publications Inc, 1997. ISBN: 978-0486696904. accessed: 25/3/25)

This book goes deeper inside the "static" and "dynamic" fields of study, going even further into the equations and notation. This will provide most of the information regarding the static-dynamic fields.

2 Use-cases of Newtonian Physics

[1.] (John von Neumann. *The Neumann compendium. Method in the Physical Sciences*. Ed. by T. Vamos F. Brody. The Unity Of Knowledge, 1955. accessed: 27/3/25)

A short compilation of both summaries and excerpts from Neumann's works, it provides insight on why modelling using Newtonian Physics is beneficial, and where modelling using Newtonian Physics is invalid.

[2.] (Luke Reilly. *The Most Impressive Physics Engine You've Never Seen.* Tech. rep. IGN, 2012. URL: https://www.ign.com/articles/2012/10/01/the-most-impressive-physics-engine-youve-never-seen. accessed: 27/3/25)

An IGN article which commentates over the revolutionary CryEngine

softbody physics back in 2014, this includes interviews on how BeamNG simulated realistic crashes and how softbody physics work.

[3.] (John Van Der Burg. *Building an Advanced Particle System*. URL: https://web.archive.org/web/20080227082516/http://www.gamasutra.com/view/feature/3157/building_an_advanced_particle_.php. accessed: 27/3/25)

A detailed guide created early in the early 2000s, this article explores how a particle system is made, which is especially useful for simulating fluid dynamics (e.g water waves, smoke physics, etc.).

[4.] (Eric Brown. "Ragdoll Physics On The DS". in: *Game Developer Magazine* [2009]. URL: https://web.archive.org/web/20131203004039/http://www.gamasutra.com/view/feature/132309/ragdoll_physics_on_the_ds.php. accessed: 27/3/25)

An article which talks about the problems with recreating ragdoll physics from the programming perspective. This is useful to showcase an example on what goes on behind the scenes when recreating Newtonian Physics.

[4i.] (Oxford Department Of Biology. "NaturalMotion: from neural research to Grand Theft Auto". In: [2018]. URL: https://www.biology.ox.ac.uk/article/naturalmotion-from-neural-research-to-grand-theft-auto. accessed: 29/4/25)

A small article which focuses on the "Euphoria" engine: dynamic animations which interact accordingly to the environment and subsequent forces acting on it. This is useful to showcase another similar yet unique way Newtonian Physics are used in simulations.

[5.] (Julianne Chiaet. "FIFA Physics". In: *Scientific American* 309.6 [2013]. URL: https://www.jstor.org/stable/26018217?seq=1. accessed: 27/3/25)

Another small article which briefly talks how fluid dynamics were simulated in the video-game franchise "FIFA" in order to create more seamless and realistic ball movement.

[6.] (Michael Eckert. *The Dawn of Fluid Dynamics: A Discipline Between Science and Technology*. Ed. by Wiley VCH. Wiley VCH, 2006. ISBN:

3-527-40513-5. URL: https://shorturl.at/cb4xQ. accessed: 27/3/25)

A scientific article talking about the history of fluid dynamics, as well as the separate applications that came from it (primitive military applications to biofluid mechanics).

[7.] (David M Bourg and Bryan Bywalec. *Physics for Game Developers: Science, math, and code for realistic effects*. O'Reilly Media, Inc., 2013. ISBN: 1449361048. URL: https://books.google.co.uk/books?id=Kd5QonEHoCwC&dq=game+physics&lr=&source=gbs_navlinks_s. accessed: 29/4/25)

A tutorial book detailing common physics and code used in games, and how are they made as such. This provides a high-level overview on what physics models abstract in order to showcase something specifically.

3 The advantages of simulating Newtonian Physics

[1.] (Rute Amadeu and João Paulo Leal. "Advantages of using computer simulations in physics learning". In: *Ensenanza de las Ciencias* 31.3 [2013]. URL: https://ensciencias.uab.cat/article/view/v31-n3-amadeu-leal. accessed: 29/4/25)

An article/study on how computer physics simulations have helped improve the teaching quality of physics lessons, and the positive correlation between physics simulations and declining failure rates.

[2.] (Serdar Kucuk and Zafer Bingul. *Robot kinematics: Forward and inverse kinematics.* INTECH Open Access, 2006. ISBN: 3-86611-285-8. accessed: 29/4/25)

A book which demonstrates how Newtonian physics and modelling how it works can be put into practice, with this example being through robot forward/reverse kinematics.

[3.] (Alexandre Koyré. "The Significance of the Newtonian Synthesis". In: *The Journal of General Education* 4.4 [1950]. URL: http://www.jstor.org/stable/27795317. accessed: 29/4/25)

An article which takes a more philosophical view on Newtonian Physics, and how it has changed the world fundamentally. This will be useful to cite from both leading up to and during the next section involving "*master*" over classical physics due to its critical view on the impact of Newtonian Mechanics.

References

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