# Predicting Newtonian Interactions with Normalized Virtual Particles

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An artificial super intelligent agent must be able to predict results of complex physical interactions quickly in order to function efficiently in the real world. In this paper I suggest an approach to solve this problem by using machine learning of Newtonian interactions as a form of normalized virtual particle. This allows the agent to compute the state of physical particles after interaction without simulating physical interaction in detail.

The following law of Newtonian motion uses dual numbers and allows arbitrary forces in a single step:

$$s' + v'\varepsilon = s + v\ \Delta t + \Delta t^2\ dt^2/m \sum i\ n\ \{\ (n - i)\ F_i\ \} + (\ v + \Delta t\ dt/m \sum i\ \{\ F_i\ \}\ )\varepsilon$$

$$dt = \Delta t / n$$
$$n \rightarrow \infty$$
$$\varepsilon = 1 / \infty$$
$$\varepsilon^2 = 0$$

By assuming `s = 0`, `v = 0`, `Δt = 1` and `m = 1` one obtains the law of a normalized virtual particle:

$$s_{norm} + v_{norm}\varepsilon = dt^2 \sum i\ n\ \{\ (n - i)\ F_i\ \} + dt \sum i\ \{\ F_i\ \}\varepsilon$$

For a physical impulse that is proportional `G` to the normalized virtual interaction:

$$s' + v'\ \varepsilon = s + v\ \Delta t + \Delta t^2/m\ G\ s_{norm} + (\ v + \Delta t/m\ G\ v_{norm}\ )\varepsilon$$

For example, the agent might design wings to fly with inspired by birds or insects. To learn itself to fly, it must be able to generalize rapidly from very little experience. One flap of a wing has a characteristic impulse function that is locally similar to small variations in movement pattern and speed. By observing the state before and after the movement of a wing, the agent will be able to predict accurately the result of small variations using a similar movement.

This is possible because the agent does not need to simulate the physical interaction in detail, but only derive the information stored in the normalized virtual particle. It is able to predict the result from slightly increasing or decreasing the speed of movement. This results in either slightly higher or lower force and lower or faster time interval, which can be used to navigate more accurately toward a goal.

The normalized virtual particle of local gravity is derived as following:

$$s_g + v_g\varepsilon = dt^2 \sum i\ n\ \{\ (n - i)\ g\ \} + dt \sum i\ \{\ g\ \}\varepsilon$$
$$s_g + v_g\varepsilon = dt^2\ g \sum i\ n\ \{\ (n - i)\ \} + dt\ g \sum i\ \{\ 1\ \}\varepsilon$$
$$s_g + v_g\varepsilon = ½\ dt^2\ g + g\varepsilon$$

This knowledge makes the agent able to navigate environments with different local gravity (e.g. Mars).