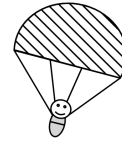


3.1 ODE with a time dependent Parameter



Again we consider the ODE for falling with a parachute:

$$\begin{aligned}\partial_t^2 u(t) &= D(t)(\partial_t u(t))^2 - g, \\ u(0) &= H, \\ \partial_t u(0) &= 0,\end{aligned}\tag{1}$$

Where now $D : \mathbb{R} \rightarrow \mathbb{R}$ with $D(t) = 2.0 \cdot (1.1 + \sin(4 \cdot t))$. For one single function D this can still be learned with the standard PINN approach. A template for the exercise is given and can be opened like before:

1. Open [Google Colab](#)
2. Select *open Notebook* and then the tab *GitHub*
3. Search: [TomF98/torchphysics](#)
4. Select the branch: *Workshop* and then [Exercise3.1.ipynb](#)

Tasks:

- a) Fill in the empty cells inside the notebook and train the neural network.
- b) Consider now, that at the beginning we have a downwards velocity $v_0 \leq 0$, e.g.

$$\partial_t u(0) = v_0.$$

Extend your implementation to learn the solution for all $v_0 \in [-10.0, 0.0]$.

Hint: Create a separate sampler for the velocity parameter. Then multiply ("*") the time sampler with the parameter sampler in order to obtain a sampler which samples tuples (t, v_0) .