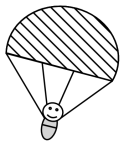
3.1 ODE with a time dependent Parameter



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 $D : \mathbb{R} \to \mathbb{R}$ 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).

3.2 Learning the Solution Operator

Now we extend the problem and try to learn multiple solutions of (1) for different functions $D(t)$. For this we use the DeepONet implementation of TorchPhysics to learn the solution operator. A template for this is given in examples/workshop/Exercise3_2.ipynb.