The proposed Matlab script has the aim of computing the current and voltage waveforms of a ferrite inductor in a non-synchronous DC-DC buck converter, whose equivalent circuit is represented in Fig. 1.

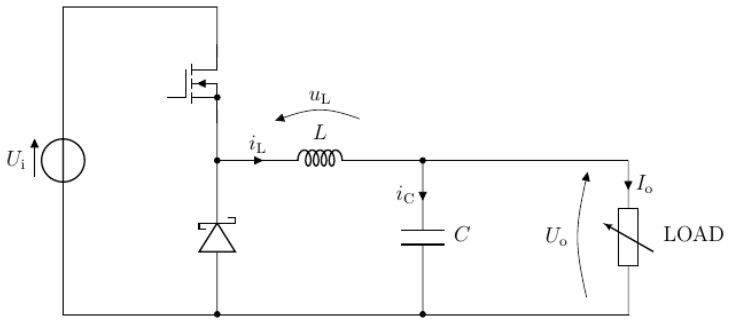

Figure 1. Circuit diagram of a non-synchronous DC-DC buck converter.

Figure 2.a. represents the system during the ON interval, while Figure 2.b. represents it during the OFF interval.

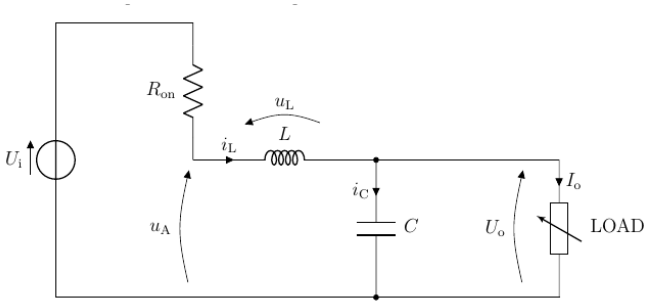

Figure 2.a. DC-DC buck converter circuit during the ON interval.

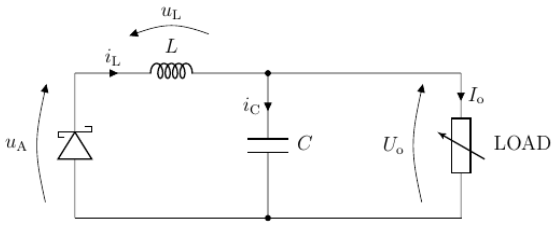

Figure 2.b. DC-DC buck converter circuit during the OFF interval.

Referring to the figures described above, the script proposes to initialize the parameters of the simulation, that are:

- U_i : Input voltage of the converter;
- U_d : Diode threshold voltage;
- R_{on} : On resistance of the converter;
- R_{off} : Off resistance of the converter;
- U_o : Load voltage;
- f_s : Switching frequency;
- T_s : Switching period;
- I_o : Average load current;
- N_{points} : Number of points of the simulation arrays .

Referring to [1], it is proposed to initialize the parameters of the analytical formulation that describes the $L(i_L)$ curve of a ferrite inductor. These parameters are:

- L_h : Upper $L(i_L)$ curve asymptote;
- L_l : Lower $L(i_L)$ curve asymptote;
- I_{30} : Current value that causes an inductance percentage drop of 30% compared to L_h ;
- I_{70} : Current value that causes an inductance percentage drop of 70% compared to L_h .

According to the parameters previously entered, the script solves the equations of the circuit through an effective iterative method, by which the inductor current waveform and the related voltage waveform are computed with successive approximations.

Figure 3. gives an example of the graphs obtained from this computation.

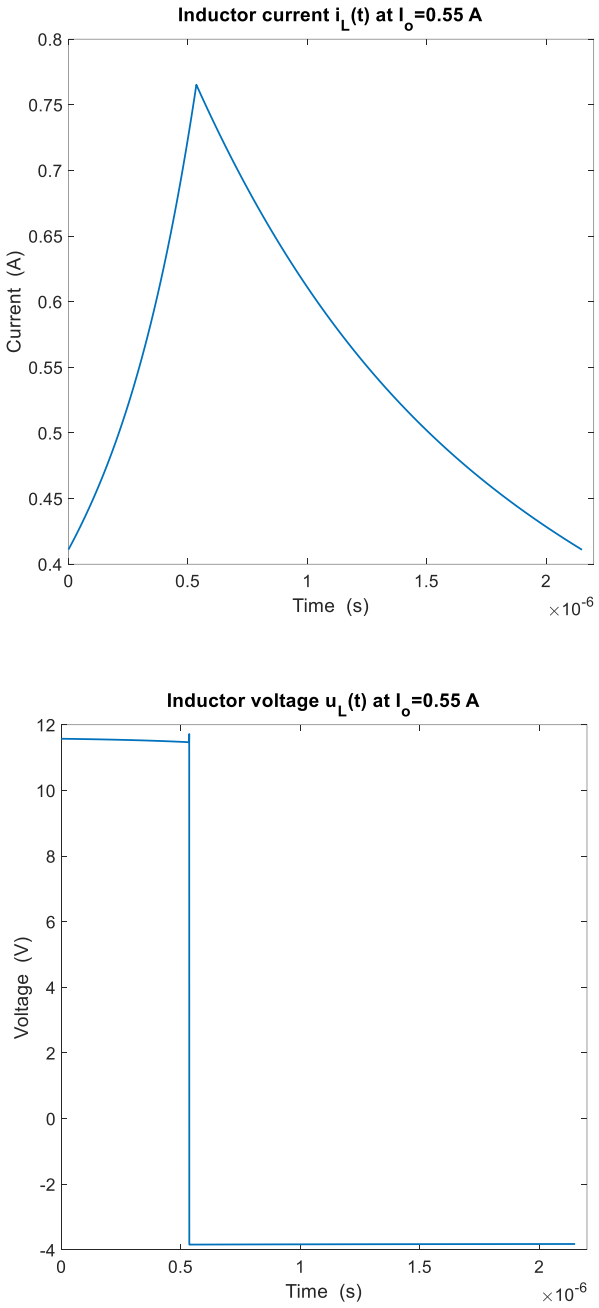

Figure 3. Example of the computation results. The upper figure shows the current waveform, while the lower figure shows the voltage waveform.

[1] Di Capua G, Femia N, Stoyka K, Storace M, Oliveri A, Lodi M (2017). Ferrite Inductor Models for Switch-Mode Power Supplies Analysis and Design, DOI: 10.1109/SMACD.2017.7981622.