# Modeling and Representation of Power Electronic Converter Parameters

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# BASIC GOALS OF THE PRESENTED PAPER

- Modeling of significant parameters of an electric power converter
- An original approach based on index matrices, which is used for generation of voltage and amperage sequences
- Software implementation
- Three - dimensional presentation of output characteristics according to the parameters

# INDEX MATRICES

$$A = \left[K,\ L,\ \{a_{k,l}\}_{k \in K, l \in L}\right] = \begin{array}{c|cccc} & l_1 & l_2 & \cdots & l_n \\ \hline k_1 & a_{k_1,l_1} & a_{k_1,l_2} & \cdots & a_{k_1,l_n} \\ k_2 & a_{k_2,l_1} & a_{k_2,l_2} & \cdots & a_{k_2,l_n} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ k_m & a_{k_m,l_1} & a_{k_m,l_2} & \cdots & a_{k_m,l_n} \end{array}.$$

# INDEX MATRICES ON ELECTRONIC COMPONENTS

Common time set : $\Theta = \{0,\ \Delta t,\ 2\Delta t,\ 3\Delta t,\ \ldots\} \subset \square$

A two-terminal element of a circuit, denoted by $c_m$,

is modelled by R-IM $F_m(t)$.

$$F_m(t) \ \square \ pro_{I_2(F_m),\{x\}} \left(X_m(t) \oplus X_o\right) = O$$

# INDEX MATRICES ON ELECTRONIC COMPONENTS

$u_m(t)$, $u_m(t - \Delta t)$ – voltage values

$i_m(t)$, $i_m(t - \Delta t)$ – amperage values

associated to this element at the respective time moments

$$X_m(t) = \begin{array}{c|c} & x \\ \hline u_m^{cu} & u_m(t) \\ i_m^{cu} & i_m(t) \\ u_m^{pr} & u_m(t-\Delta t) \\ i_m^{pr} & i_m(t-\Delta t) \end{array} \; ; \qquad X_o = \begin{array}{c|c} & x \\ \hline o & 1 \end{array} \; .$$

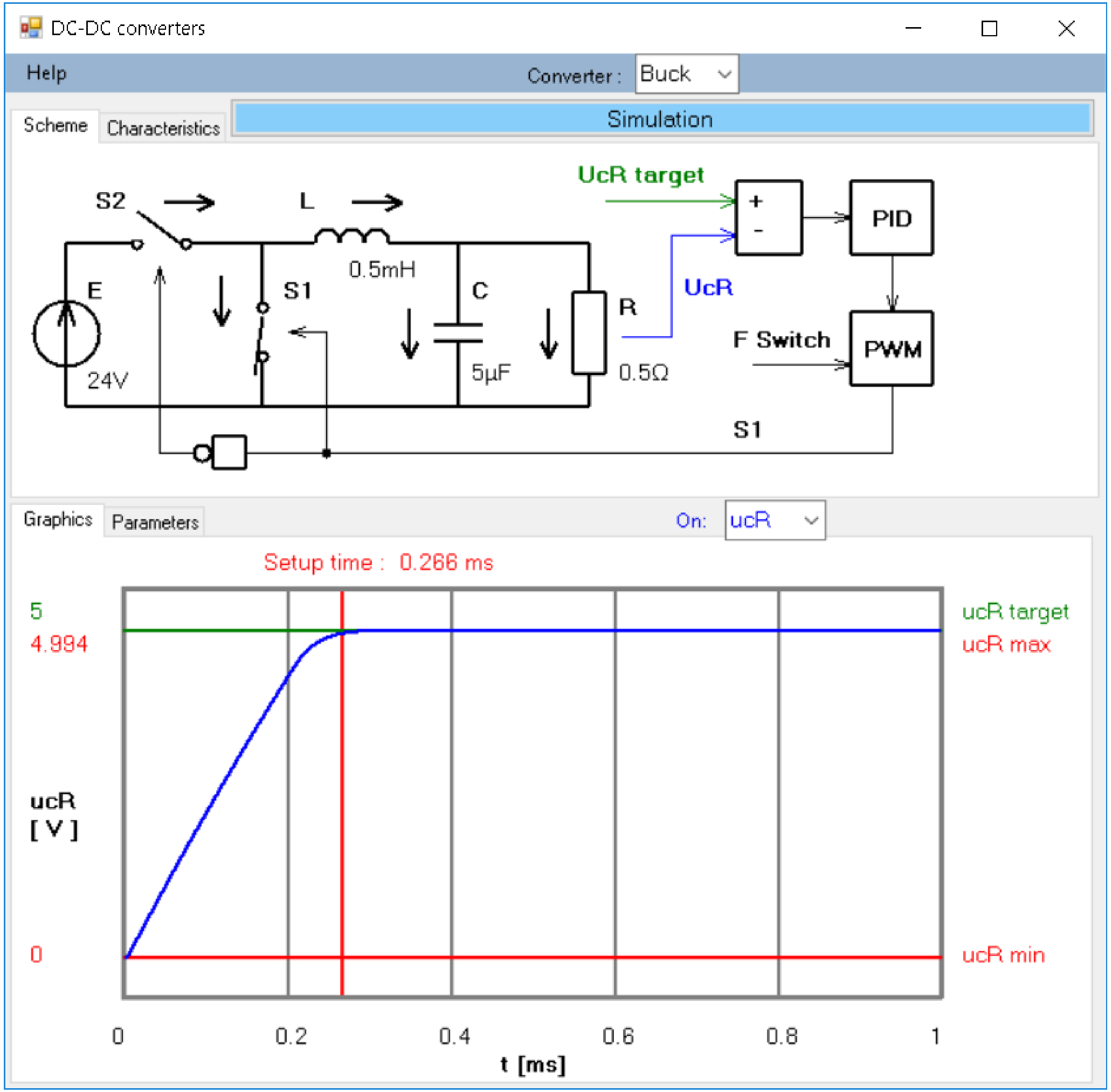
# INDEX MATRICES ON ELECTRONIC CIRCUITS

A common mathematical model of components:

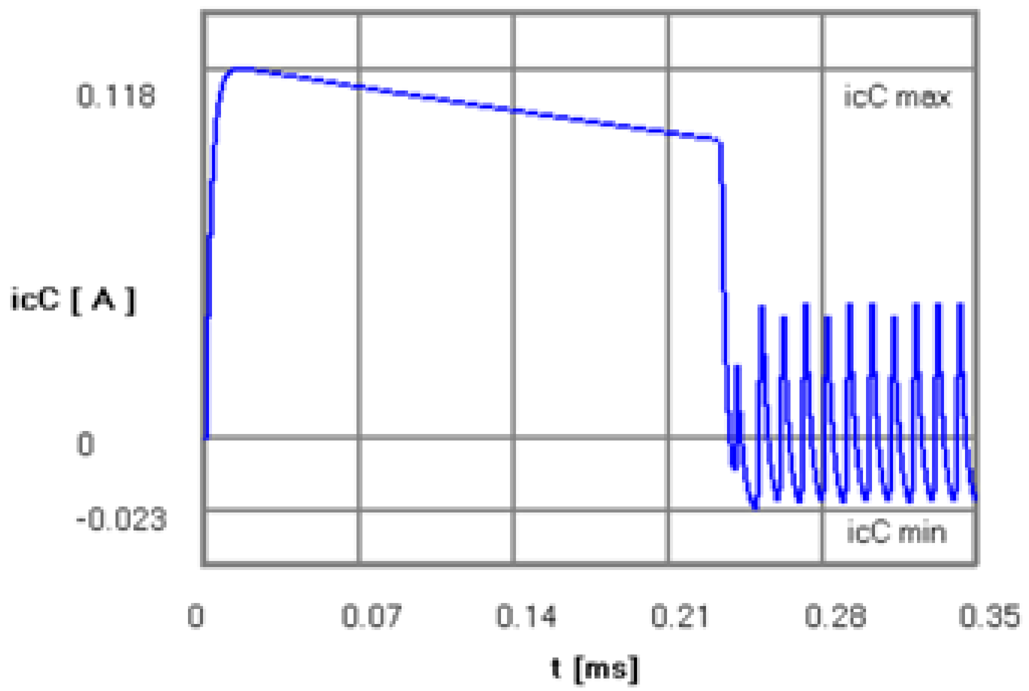
$$F_M(t) = \bigoplus_{m \in M} F_m(t)\,;$$

$$X(t) = \left( \bigoplus_{m \in M} X_m(t) \right) \oplus X_o\,;$$

$$F_M(t) \;\square\; pro_{I_2\left(F_M(t)\right), \{x\}} X(t) = O\,.$$



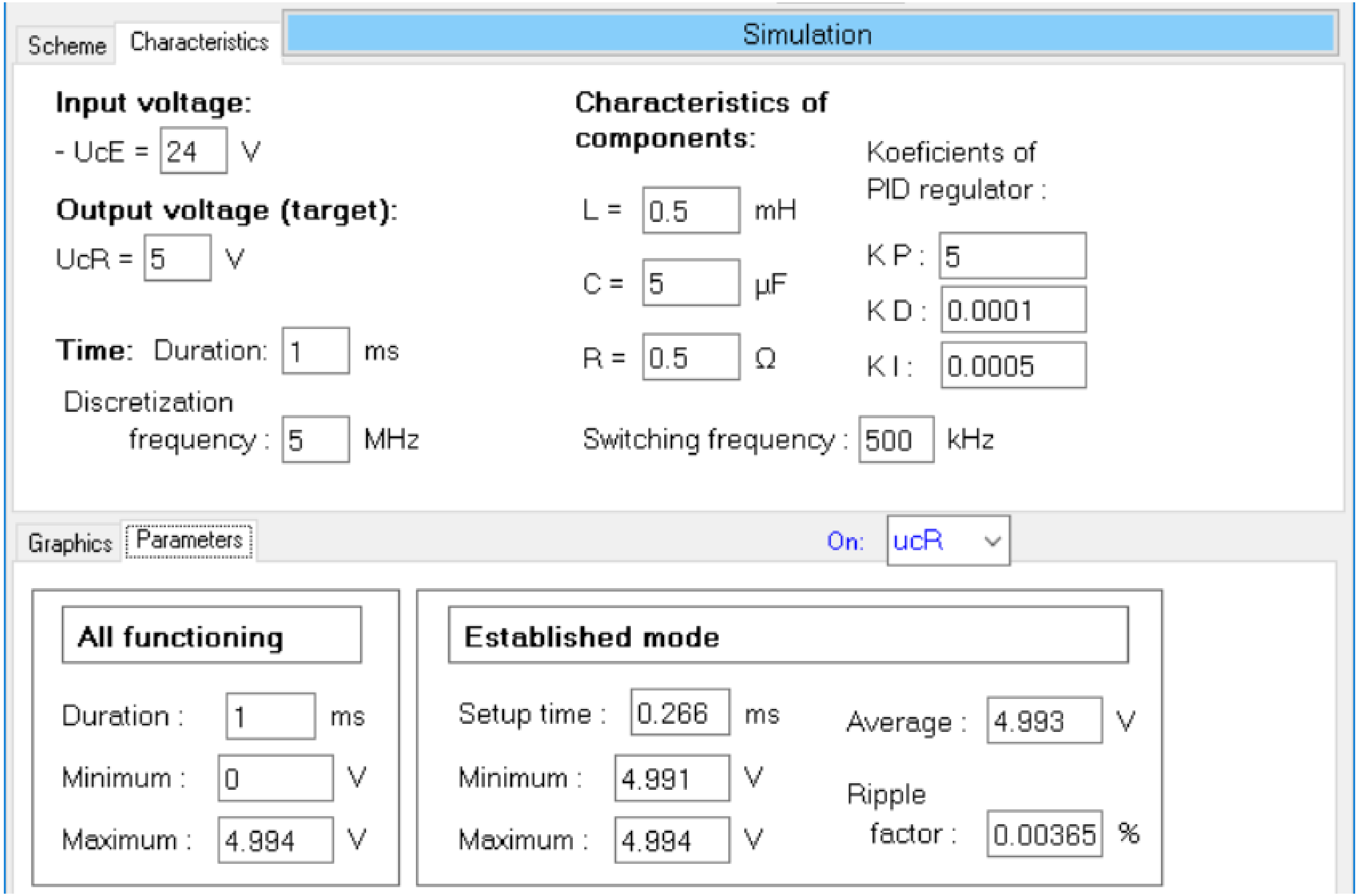

# Scheme and graphics on output voltage in software implementation

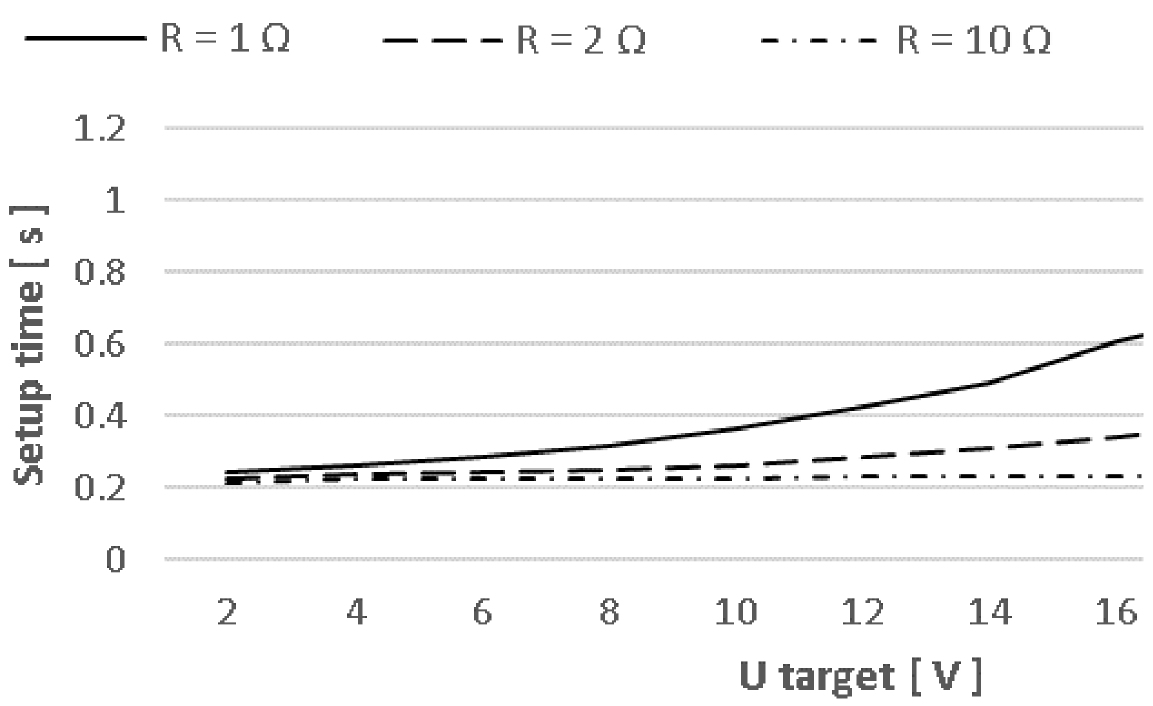



CAPACITOR VOLTAGE IN

SOFTWARE IMPLEMENTATION

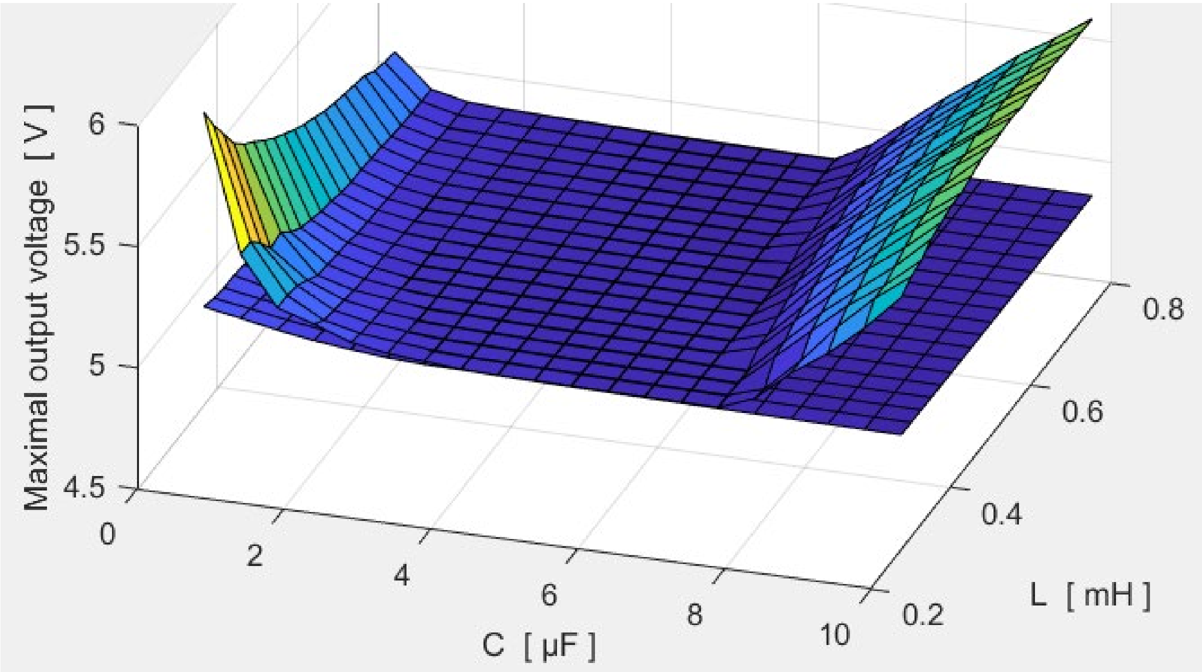
# INPUT PARAMETERS AND OUTPUT CHARACTERISTICS



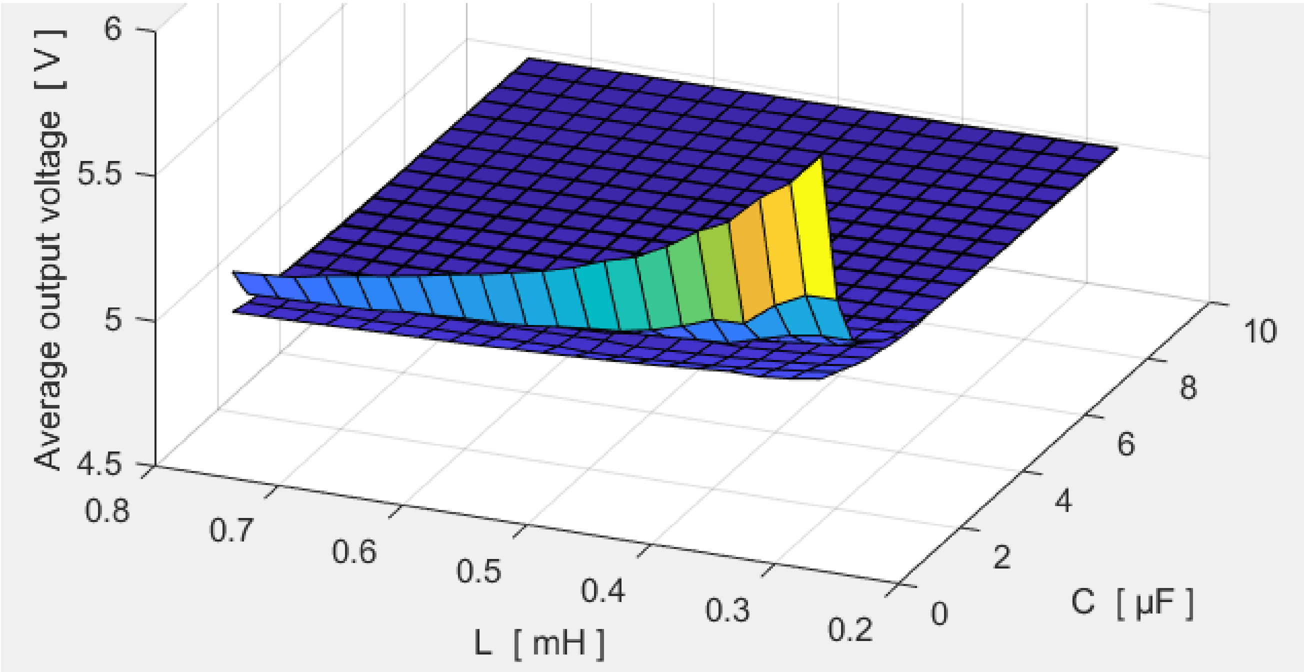



# TWO-DIMENSIONAL REPRESENTATION OF SETUP TIME

# THREE-DIMENSIONAL REPRESENTATIONS



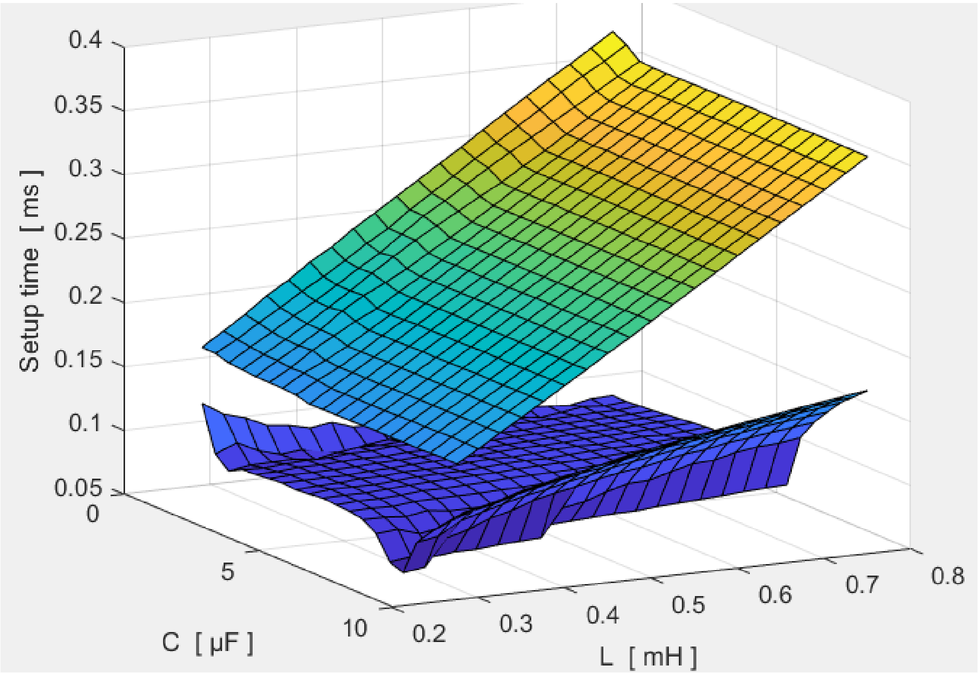

MAXIMAL OUTPUT VOLTAGE (1)



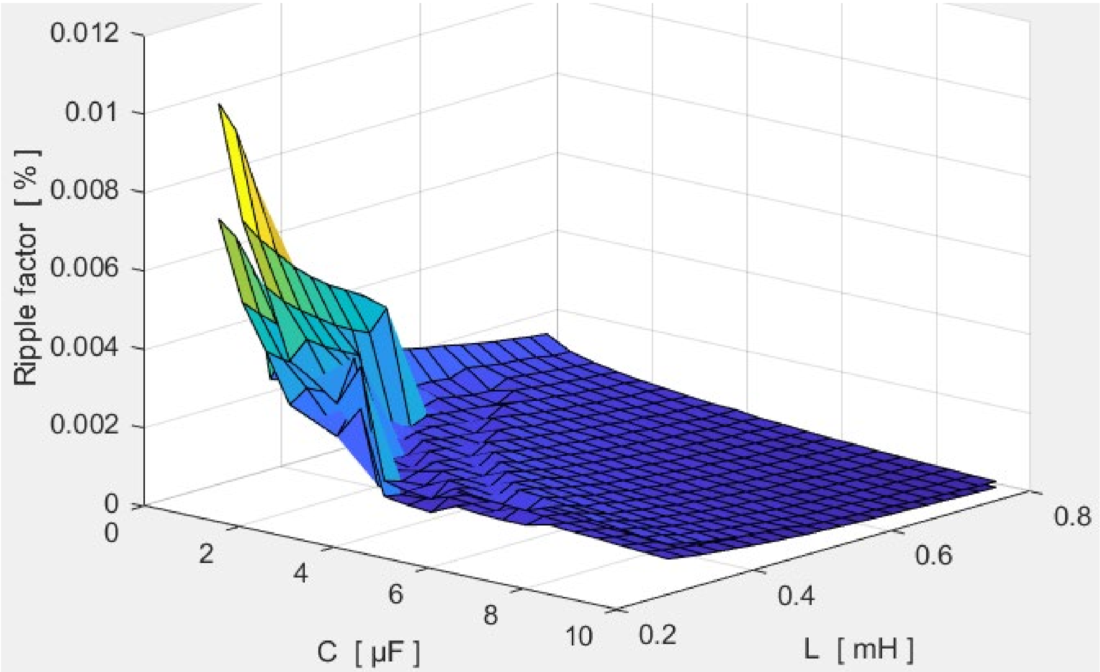

AVERAGE OUTPUT VOLTAGE (1)

Output amperage: 1 – 10 A; $K_P = 5$; $K_D = 1.\ 10^{-4}$

# THREE-DIMENSIONAL REPRESENTATIONS



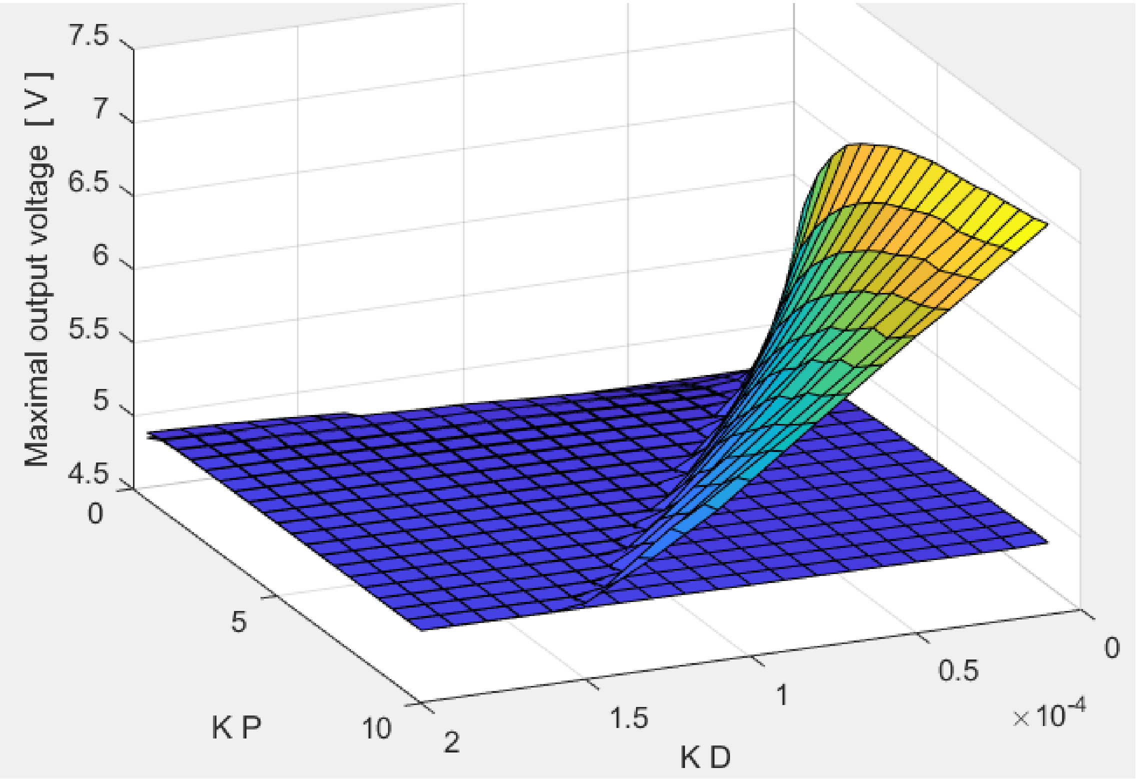

SETUP TIME (1)



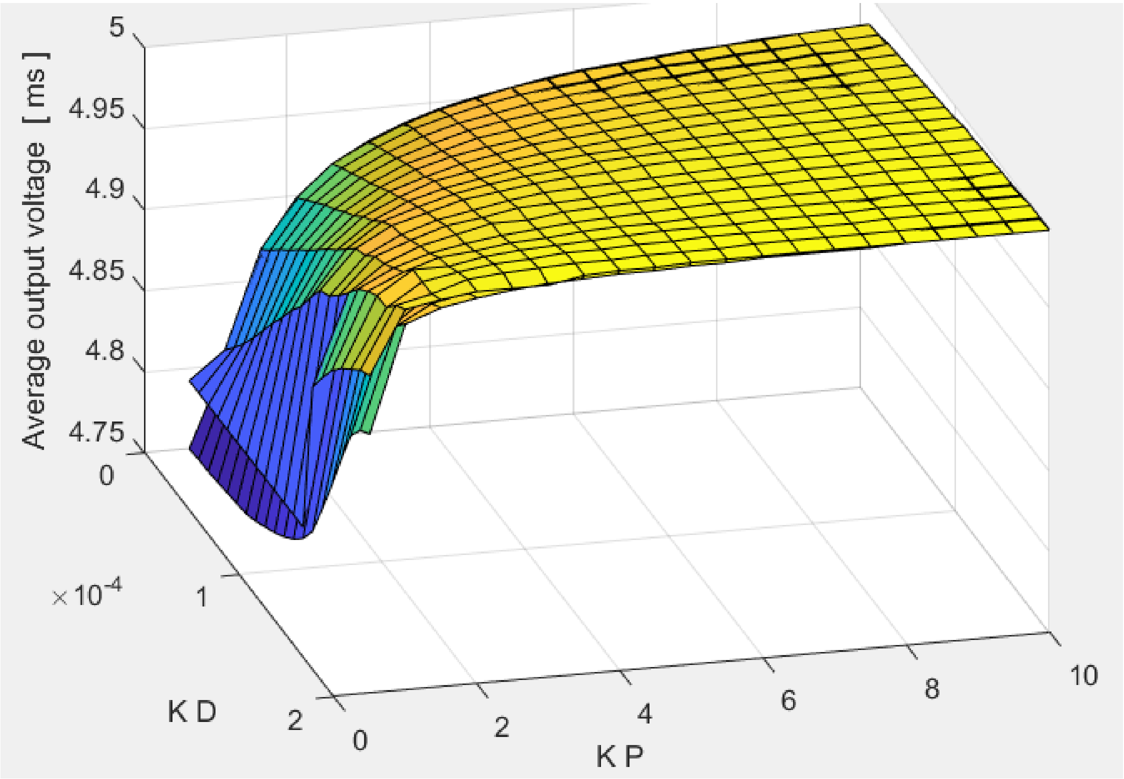

RIPPLE FACTOR (1)

Output amperage: 1 – 10 A; $K_P = 5$; $K_D = 1.\ 10^{-4}$

# Three-dimensional representations



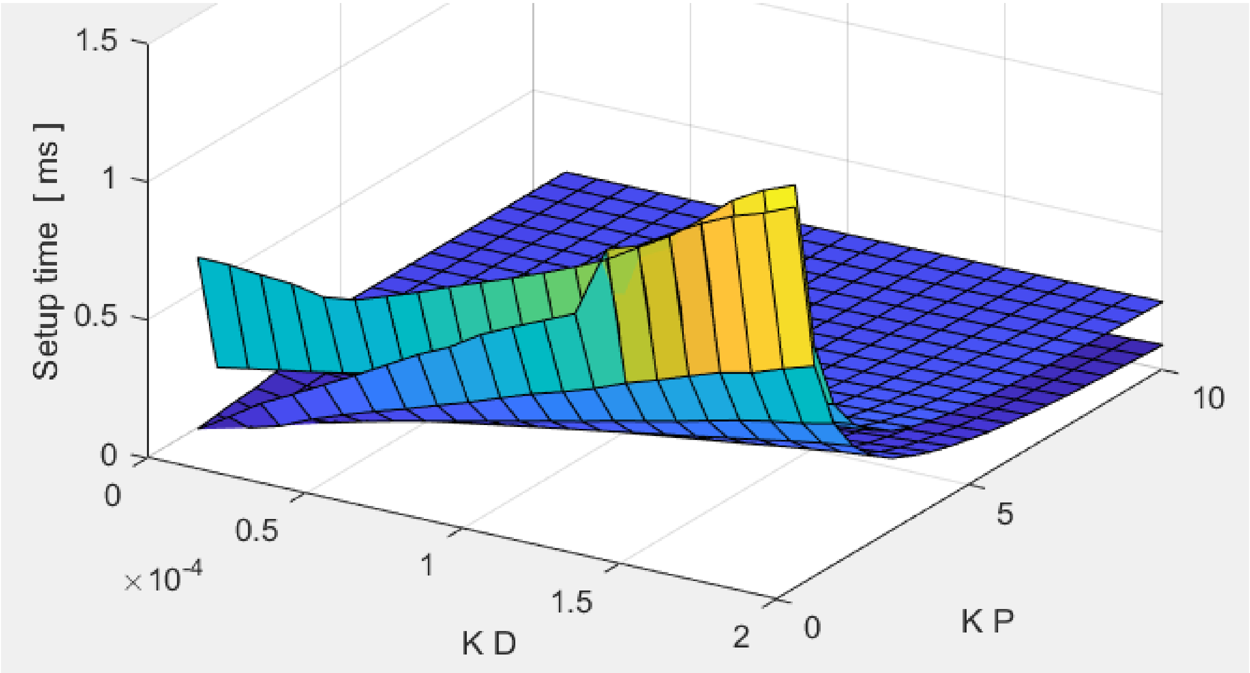

Maximal output voltage (1)



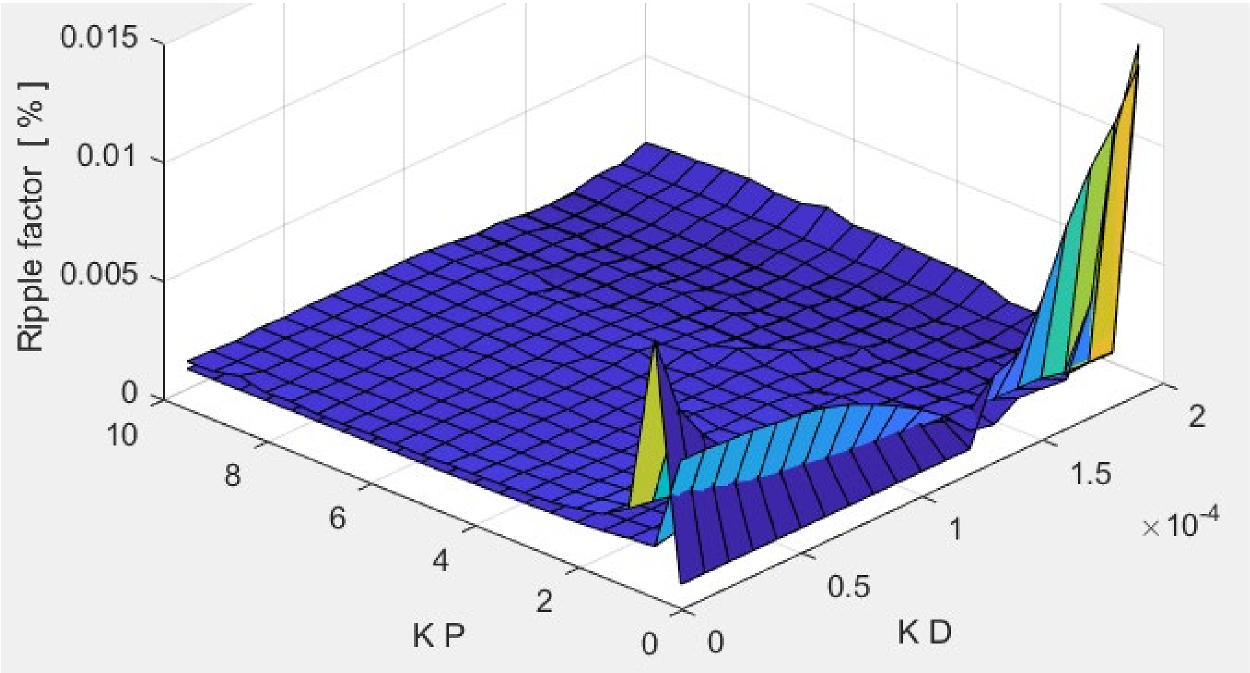

Average output voltage (1)

Output amperage: 1 – 10 A; L = 0.5 mH; C = 5 μF

# THREE-DIMENSIONAL REPRESENTATIONS




SETUP TIME (1)

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