Analysis controller for boost converter with SISOTOOL MATLAB

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Reference: http://www.academia.edu/download/58863760/algamluoli-2017-ijca-915244.pdf

Description: "Nowadays, most applications like renewable energy, hybrid electric car and laptops charger use dc to dc converter like buck, buck boost and boost converter to reduce from battery size. Most company look at to reduce from size especially in aerospace application to reduce from weight. So, the controller is more important in these applications to get high response in output voltage. In this paper, two controllers in S and Z domain are made for boost converter by using SISOTOOL MATLAB. Circuit diagram of boost converter is shown below in fig (1)."

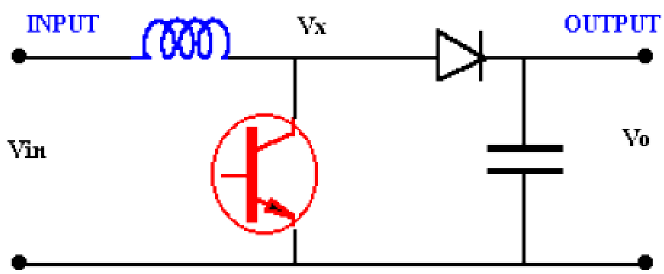


Figure (1) Boost converter Circuit Diagram

Since analysis of the circuit is not related to our subject, it is not said. Instead, the following transfer function is used to analyze the system with SISOTOOL MATLAB.

$$\frac{V_{op}(s)}{d_p(s)} = \frac{\frac{V_o}{(1-D)}\left(1 - \frac{sL}{(1-D)^2 R}\right)}{\frac{s^2 LC}{(1-D)^2} + \frac{sL}{(1-D)^2 R} + 1}$$

Also we have L=1.6875e-004 C=2.7778e-004.

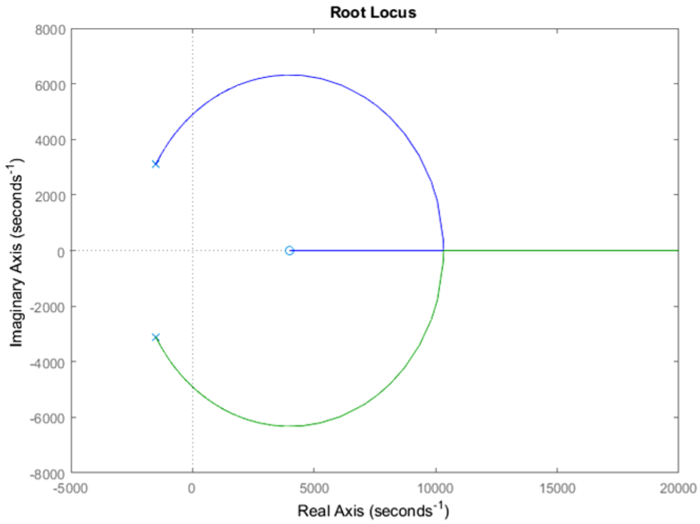
"Where D is duty cycle, Vop is output voltage and d p is duty cycle. After substituting the values in transfer function, it will be:"

$$\frac{-0.003S + 12}{8.333 \times 10^{-8} S^2 + 0.00025S + 1}$$

"After rearrange the transfer function in order to find poles, zeros and gain, it will be as shown below:"

$$\frac{-36000(S - 4000)}{S^2 + 3000S + 1.2 \times 10^7}$$

The root locus of this transfer function as shown below:

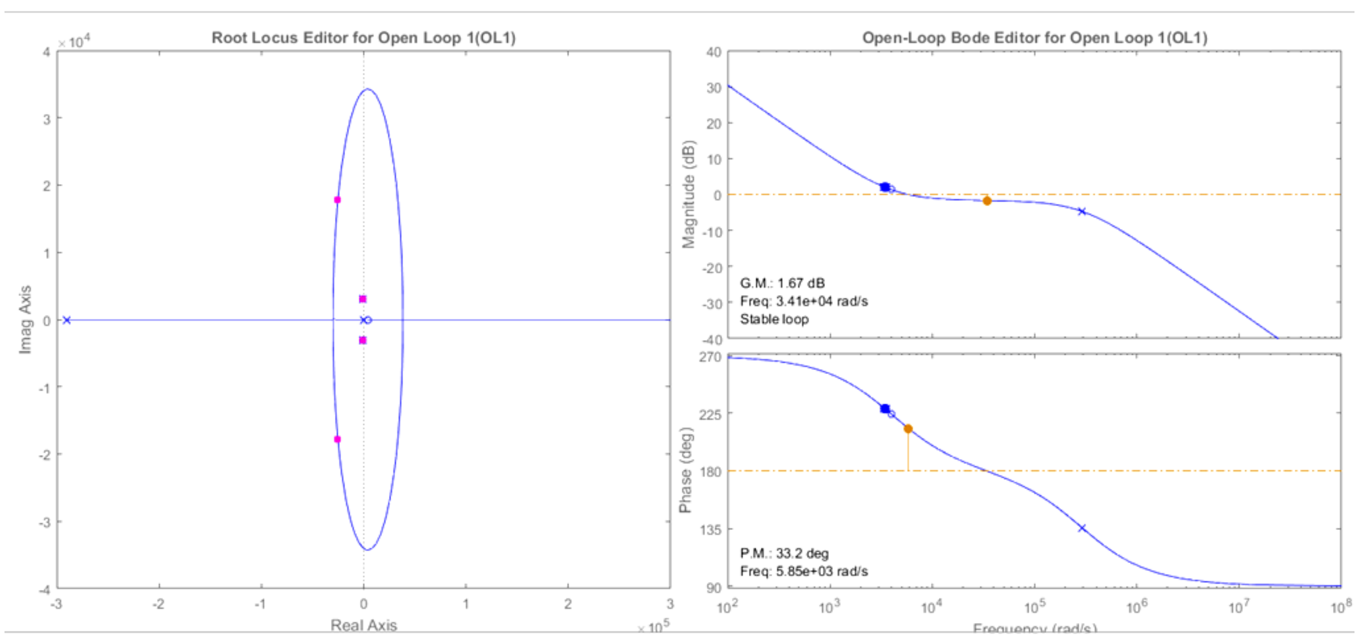


With SISOTOOL MATLAB we can find a controller for this unstable system:

$$\frac{6.65(S^2 + 3000S + 1.2e007)}{S(S + 2.9e005)}$$

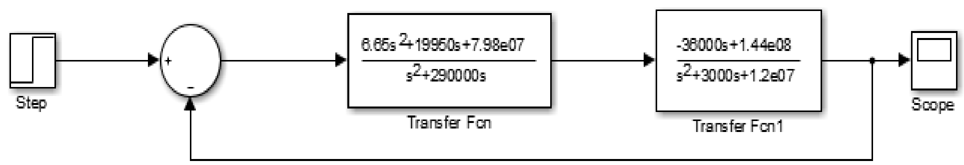
So the function of system with root locus is:

$$\frac{-239400S^3 + 2.394e08S^2 + 1.149e16}{S^4 + 293000S^3 + 8.82e08S^2 + 3.48e12S}$$

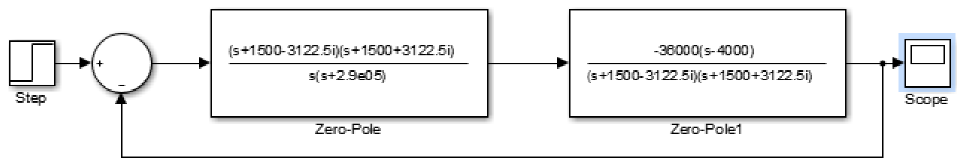


“The poles, zeros and gain of the controller are (2.9e005, 0), (-1500-3122.5i,-1500+3122.5i) and 6.65 respectively. This controller has complex zero to cancel complex pole in plant. It has real far pole, and one integrator to get zero steady state error. The design requirements are given (damping factor =0.707, natural freq. =2*pi*5000). After using SISOTOOL manger is to choose the best controller for the system.”

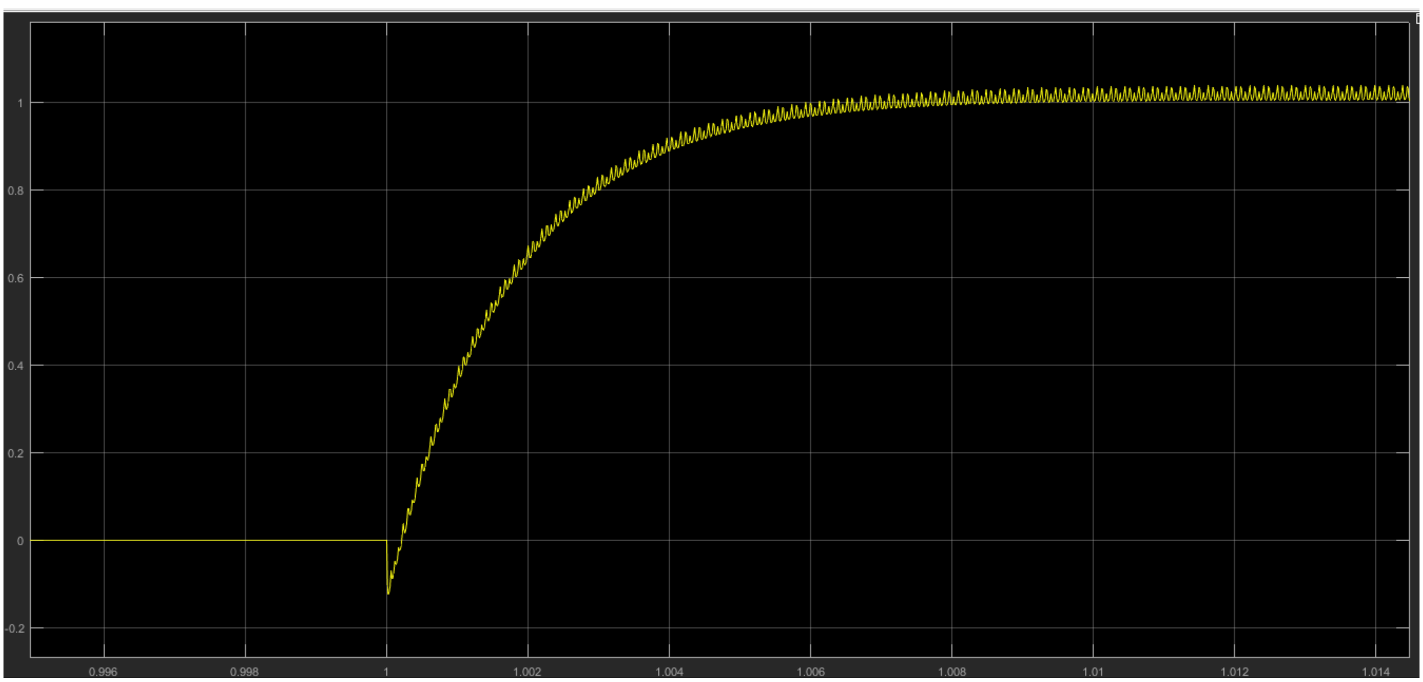
Now we simulate this system with controller and unit feedback in SIMULINK MATLAB:



OR



And for step input system export this response:



This plot shows us that system with controller is fast and stable.

So with SISOTOOL MATLAB we can find a controller for unstable system and stabilize it.