SOLAR SIMULATOR DESIGN

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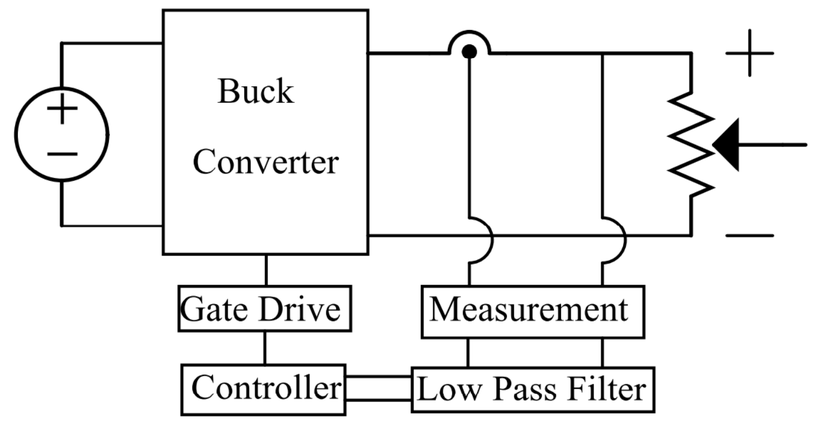
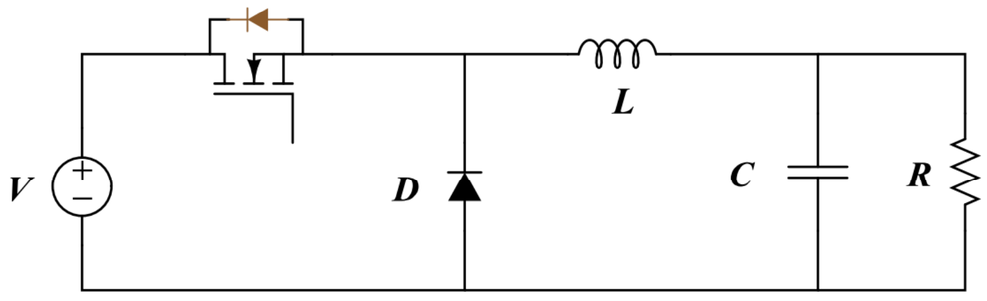
AIM OF THE PROJECT

- Designing a solar panel simulator circuitry whose output characteristic is exactly the same with the current-voltage characteristic of a specified solar panel.
- The proper DC-DC converter topology is going to be implemented and a digital control system is going to be designed.

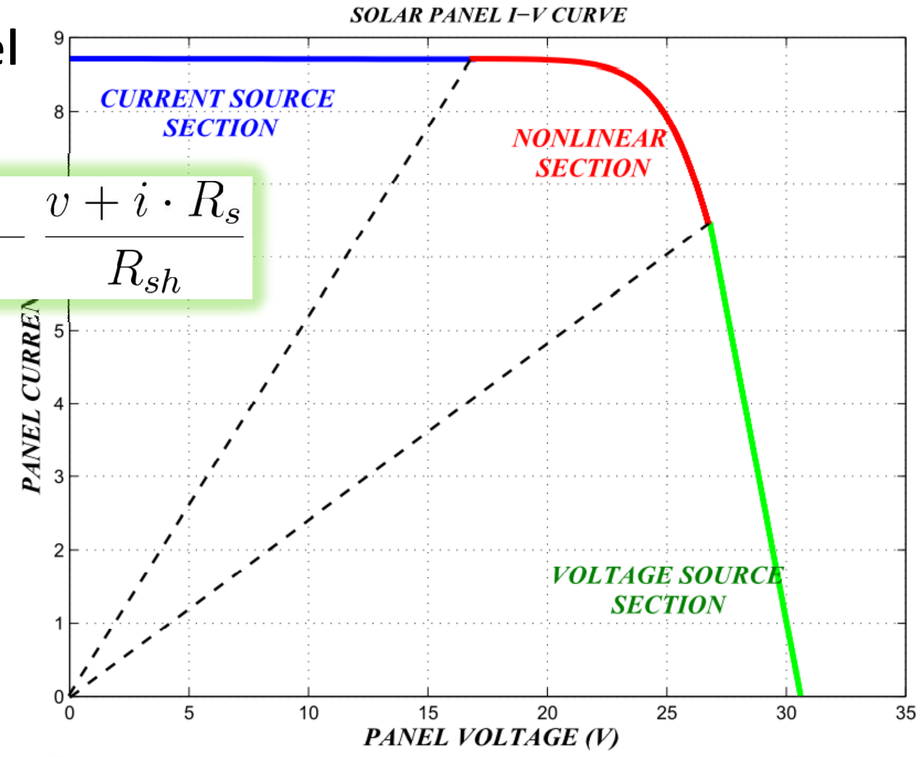


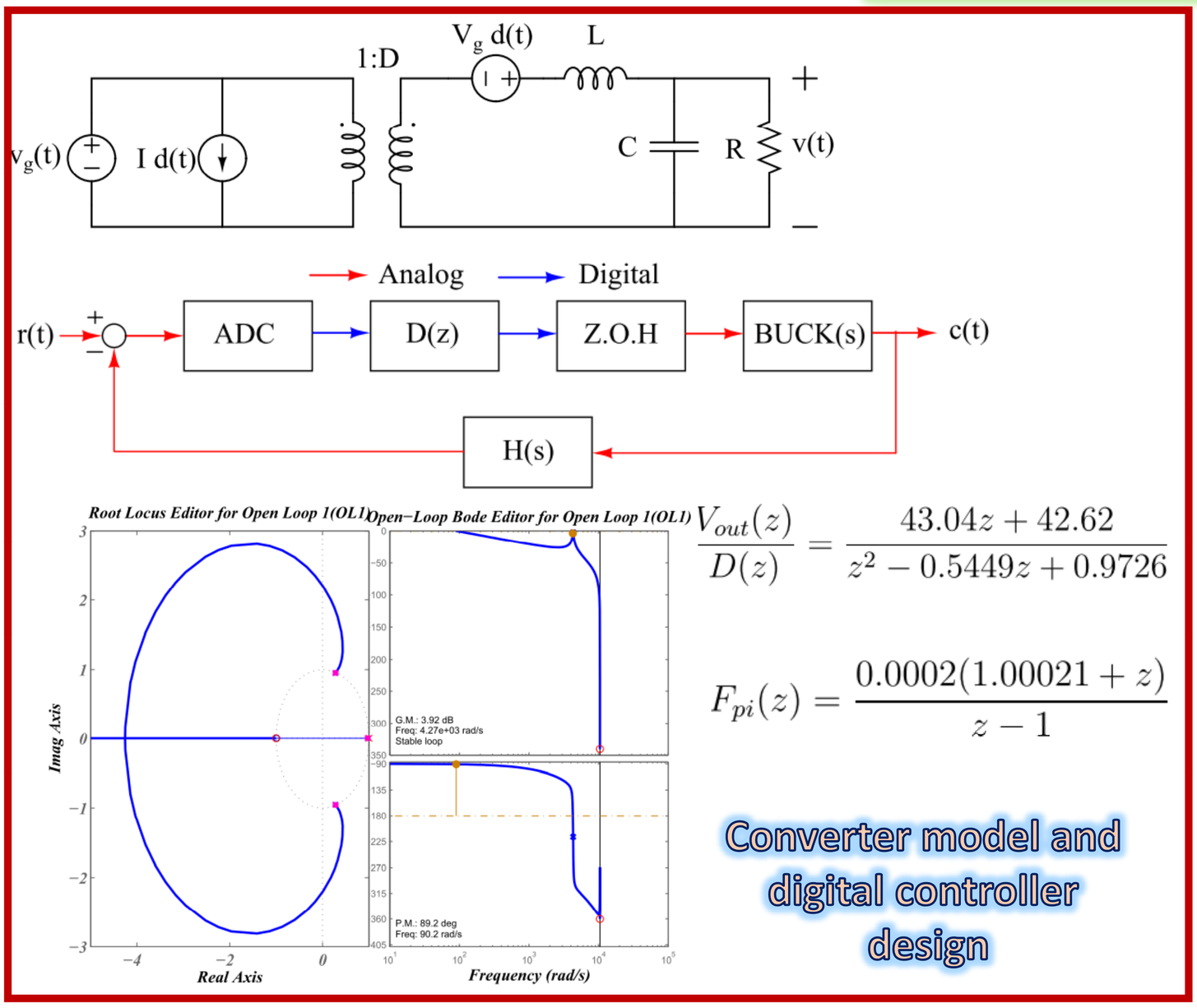
Buck Converter



Photovoltaic panel I-V characteristic

$$i = I_{ph} - I_o(e^{\frac{v+i\cdot R_s}{n_s \cdot V_t}} - 1) - \frac{v + i \cdot R_s}{R_{sh}}$$

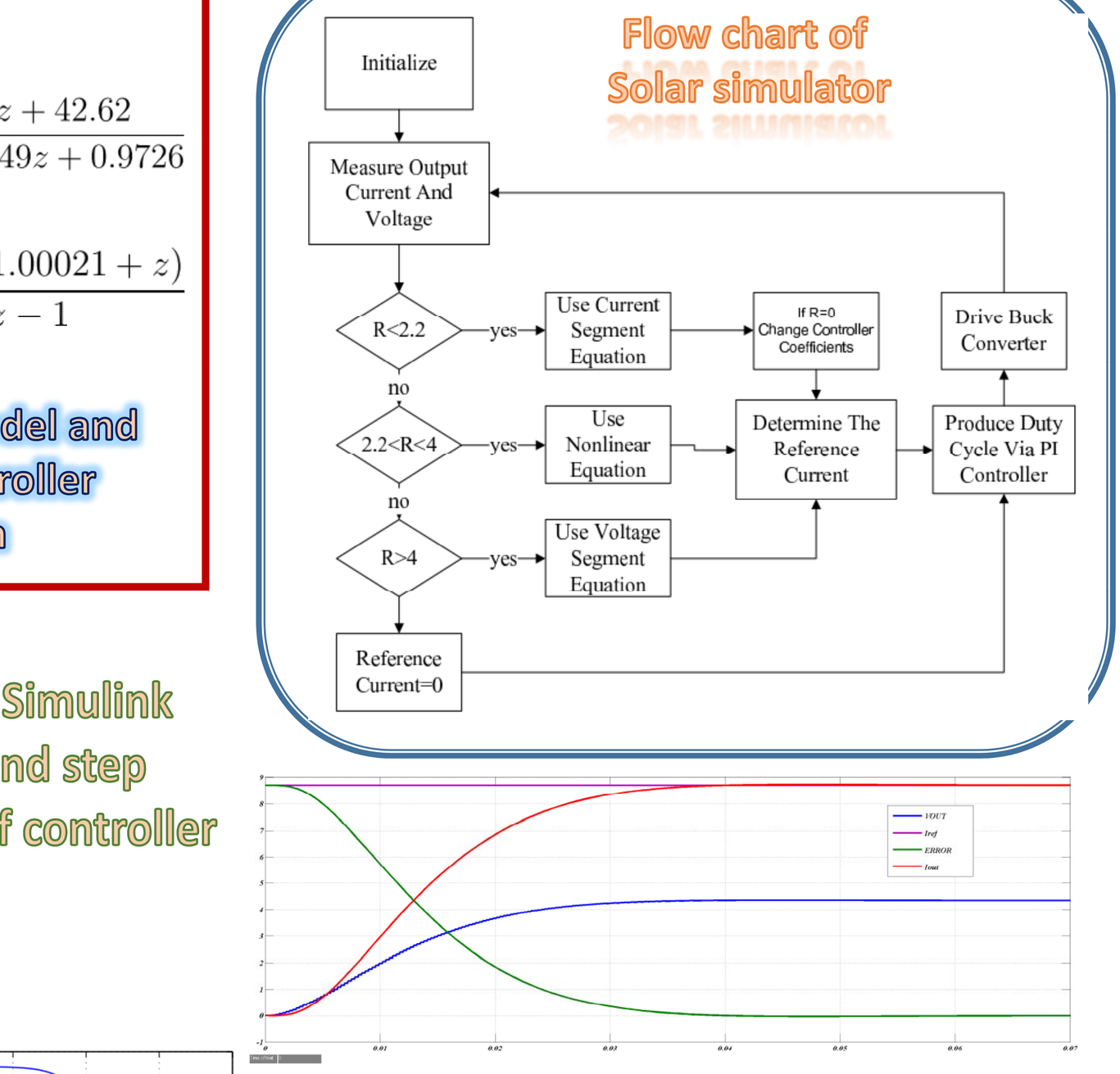




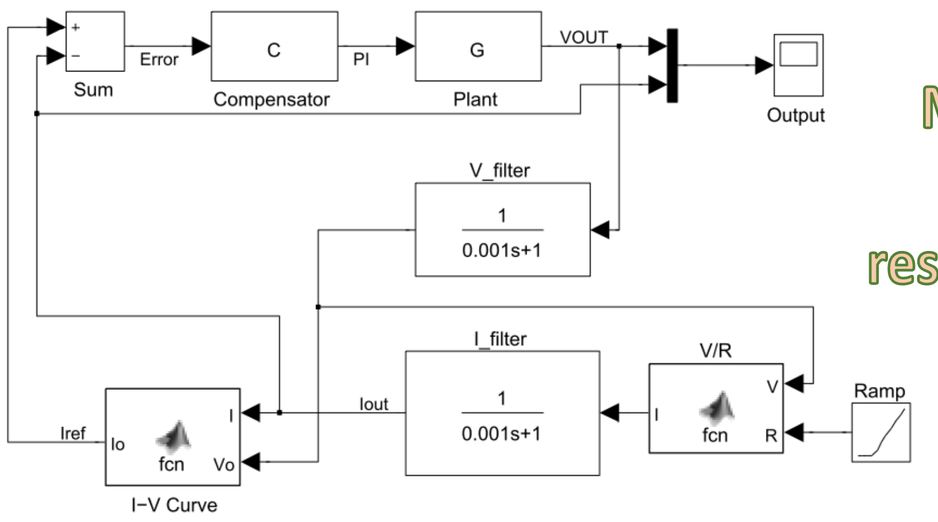
$$\frac{V_{out}(z)}{D(z)} = \frac{43.04z + 42.62}{z^2 - 0.5449z + 0.9726}$$

$$F_{pi}(z) = \frac{0.0002(1.00021 + z)}{z - 1}$$

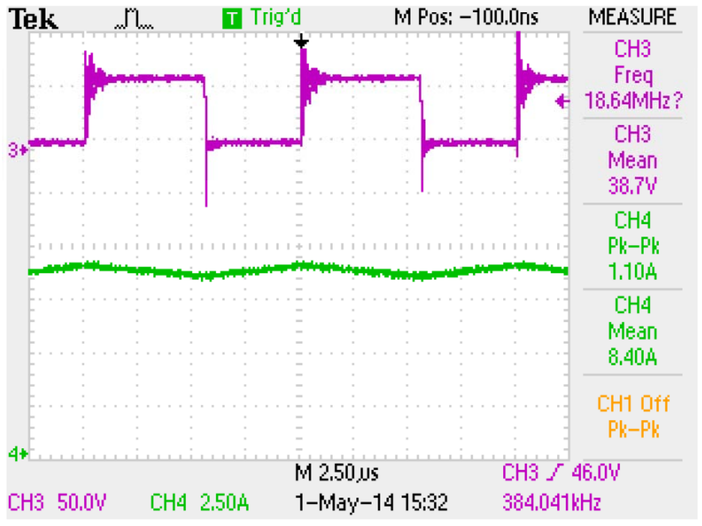
Converter model and digital controller design



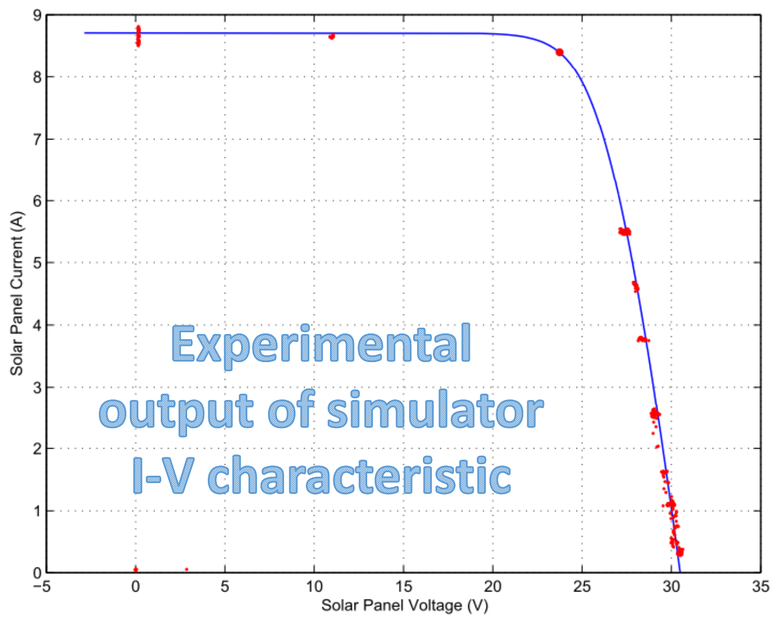
Flow chart of Solar simulator



MATLAB Simulink model and step response of controller



Drain-source voltage and Inductor current at maximum power



Experimental output of simulator I-V characteristic

CONCLUSIONS

- By taking a commercial solar panel as a reference, a simulator has been designed and implemented
- A new hybrid algorithm has been developed and implemented successfully by using the mathematical model of the solar panel
- A complete digital control system has been designed by using the latest engineering tools
- Valuable experiences have been gained about circuit design, software development and the discrete time analysis and design.