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Analysis And Simulation For Active Switched Inductor-Capacitor Converter With Voltage Multiplier For Microinverter Applications

Mohammad Alrefai[1], Ahmad Elkhateb[1], and Robert Best[1]*

[1] School of Electronics, Electrical Engineering and Computer Science (EEECS), Queen's University, Belfast BT9 5AH, United Kingdom

*a.elkhateb@qub.ac.uk

Introduction

Integration of renewable energy resources has been a promising alternative to reduce some global issues. Microinverters are an effective solution to accelerate this integration and play an essential role because of their features. It is an interface between the photovoltaic cells and the utility grid. Photovoltaics arrays sometimes suffer from mismatching and partially shaded conditions to extract maximum power point tracking. However, the proposed research aims to achieve high-performance characteristics for microinverters in terms of high voltage conversion and increased efficiency for partially shaded photovoltaic systems. Integrating different voltage boosting techniques with the conventional boost converter is the basis of the proposed topology to enhance the overall efficiency of the boost converter. The proposed topology will provide high voltage gain, high efficiency, high reliability, and lower voltage stress compared to its counterparts and work under partial shading conditions at maximum power point tracking to improve utilisation.

WHY Photovoltaic Systems?

- The growth of installed photovoltaic systems approached one Terawatt in April 2022, and it is expected to continue growing to reach 2.3 Terawatt in 2025.
- Out of the total new global renewable power generating capacity, photovoltaic systems added more capacity than all other renewable technologies combined, accounting for 56 % of full capacity.
- The cost of utility-scale solar remains competitive with conventional resources.
- However, photovoltaic systems still account for only about 4% of global electricity demand compared to non-renewable sources, which provided more than 70%.
- Photovoltaic systems are expected to contribute around 16% to global energy production by 2050.

Table I: The estimated cost of energy resources in the United Kingdom and the United States.

Estimated Cost					
United Kingdom (£/MWh)			United States ($/MWh) + (Subsidies)		
Solar	Offshore wind	CCGT	Solar	Nuclear	Coal
44	57	85	27	29	42

Proposed Topology: Integrating the voltage multiplier technique with the active switched inductor-capacitor converter is the proposed topology to enhance the voltage gain of the converter.

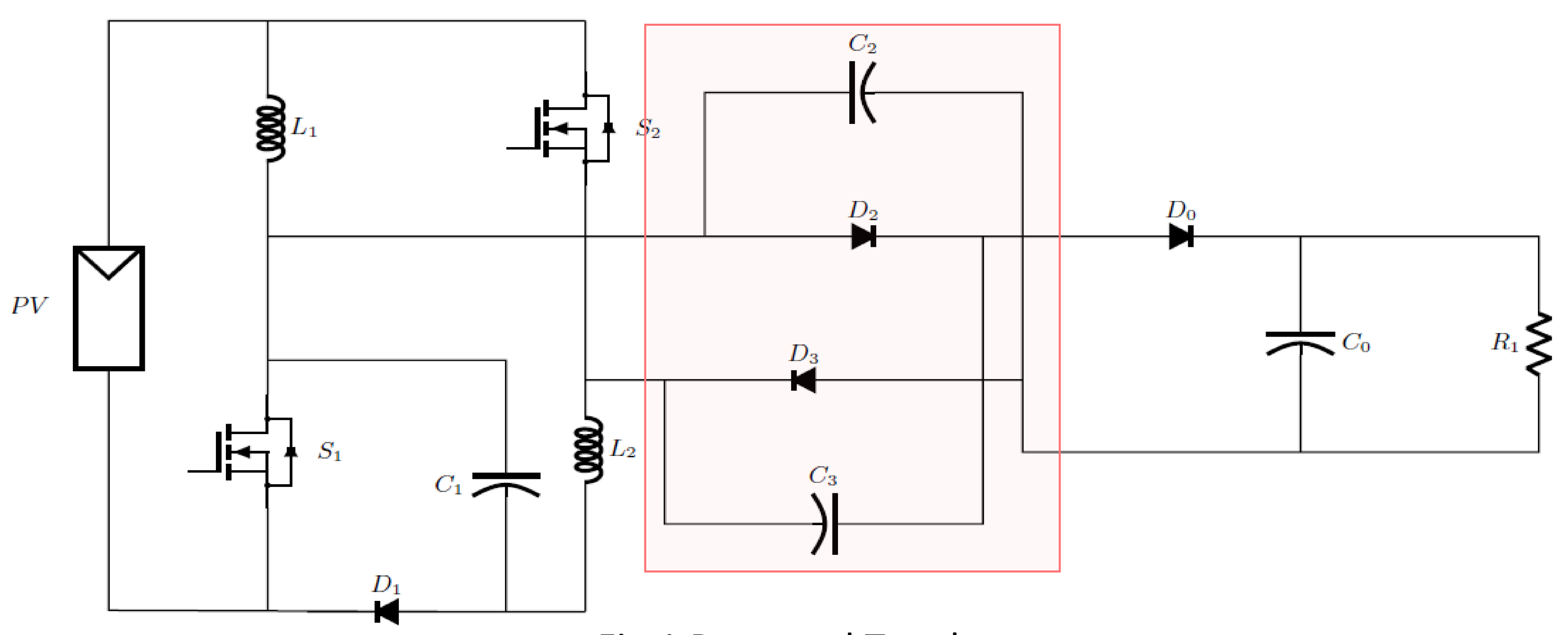

Fig.1 Proposed Topology.

Results: Even though the number of components increased, the proposed converter has efficiently shown an enhanced voltage gain compared with the active switched inductor-capacitor converter, and the active switched inductor converter at a lower duty ratio also reduced the voltage stress across the active switches.

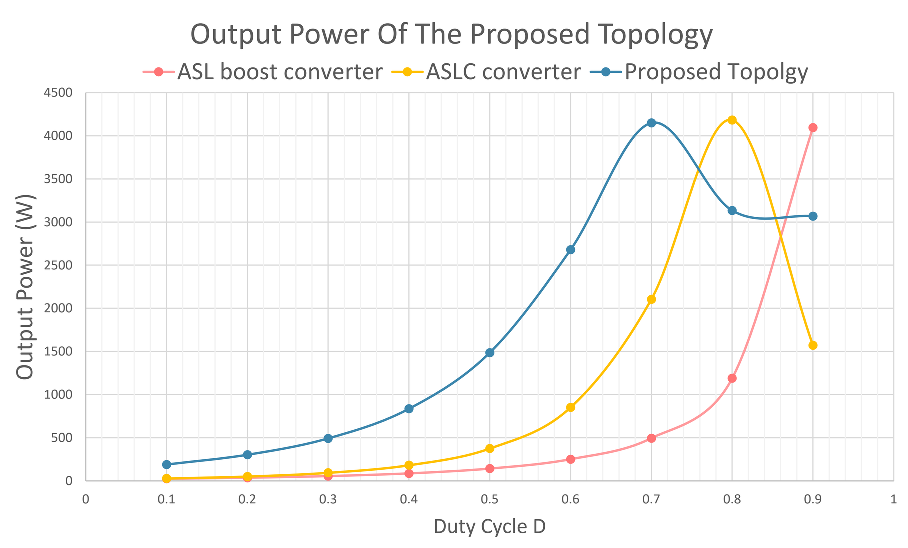

Fig.2 Voltage gain of the proposed topology with similar converters.

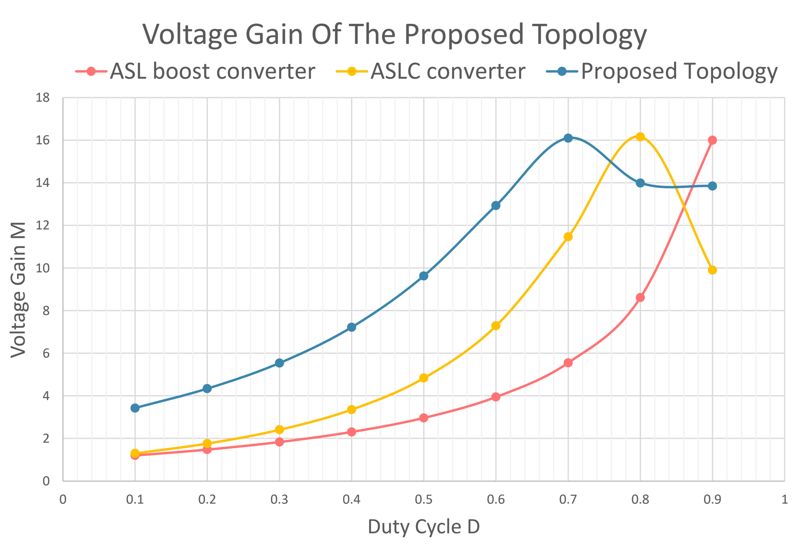

Fig.3 Output power of the proposed topology with similar converters.

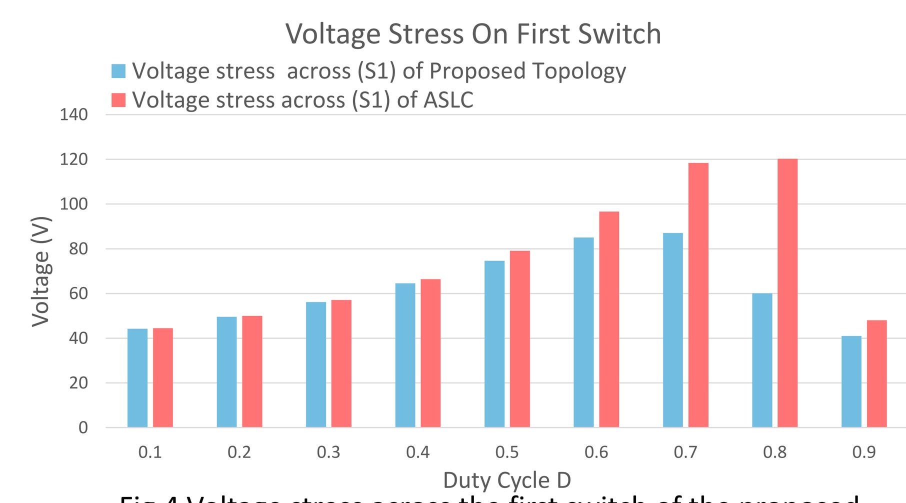

Fig.4 Voltage stress across the first switch of the proposed topology compared with the ASLC converter.

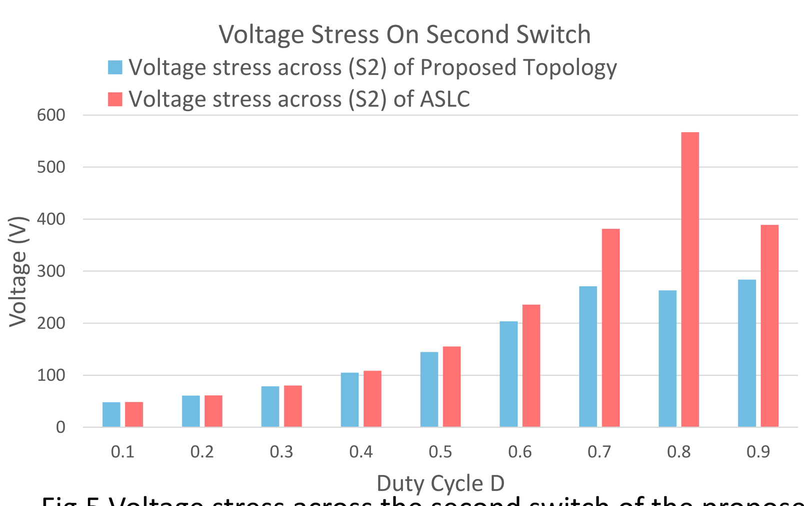

Fig.5 Voltage stress across the second switch of the proposed topology compared with the ASLC converter.

Simulation Model

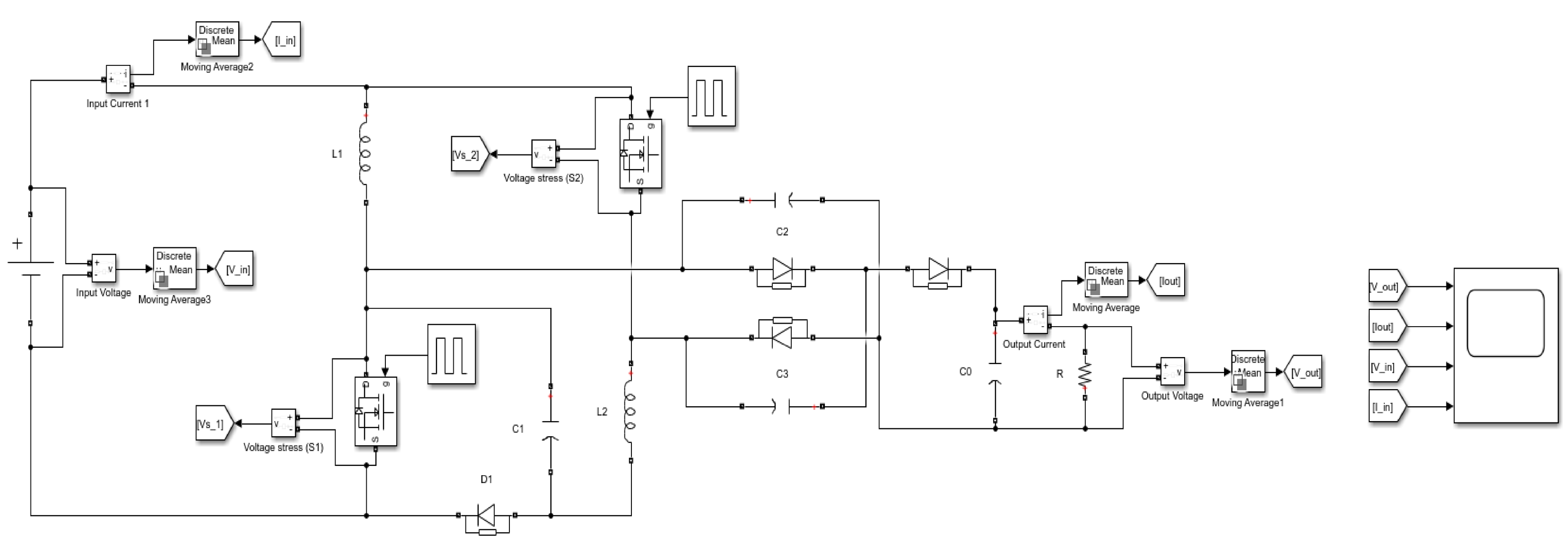

Fig.6 The simulation model of the proposed topology.

Simulation

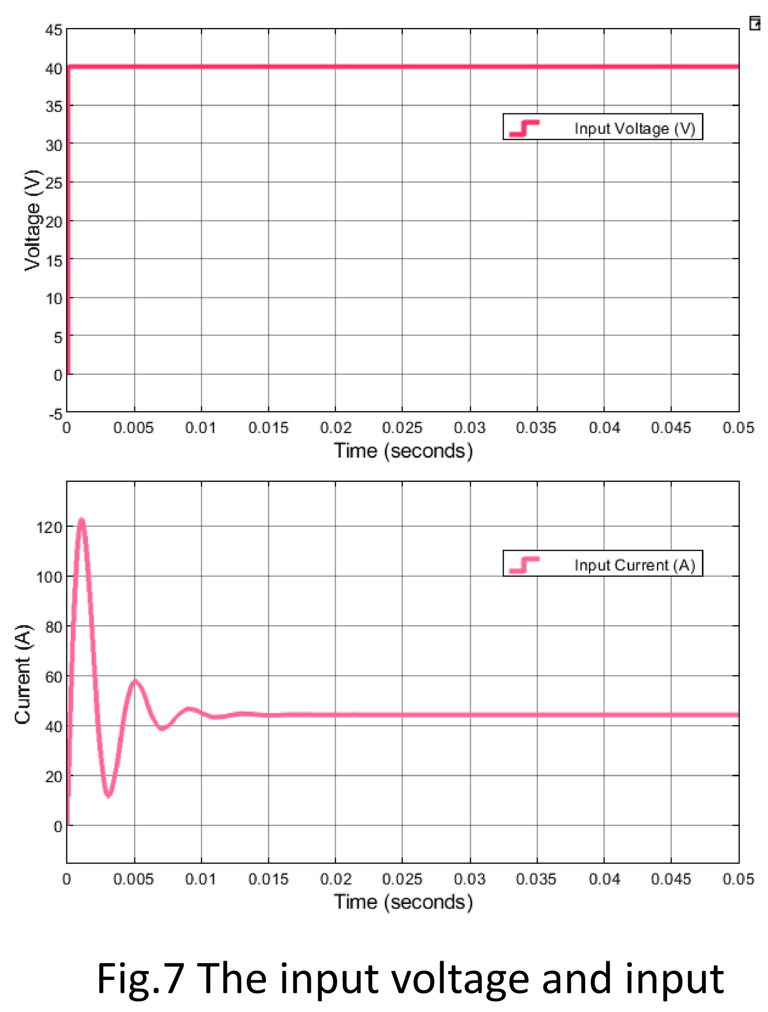

Fig.7 The input voltage and input current of the proposed topology.

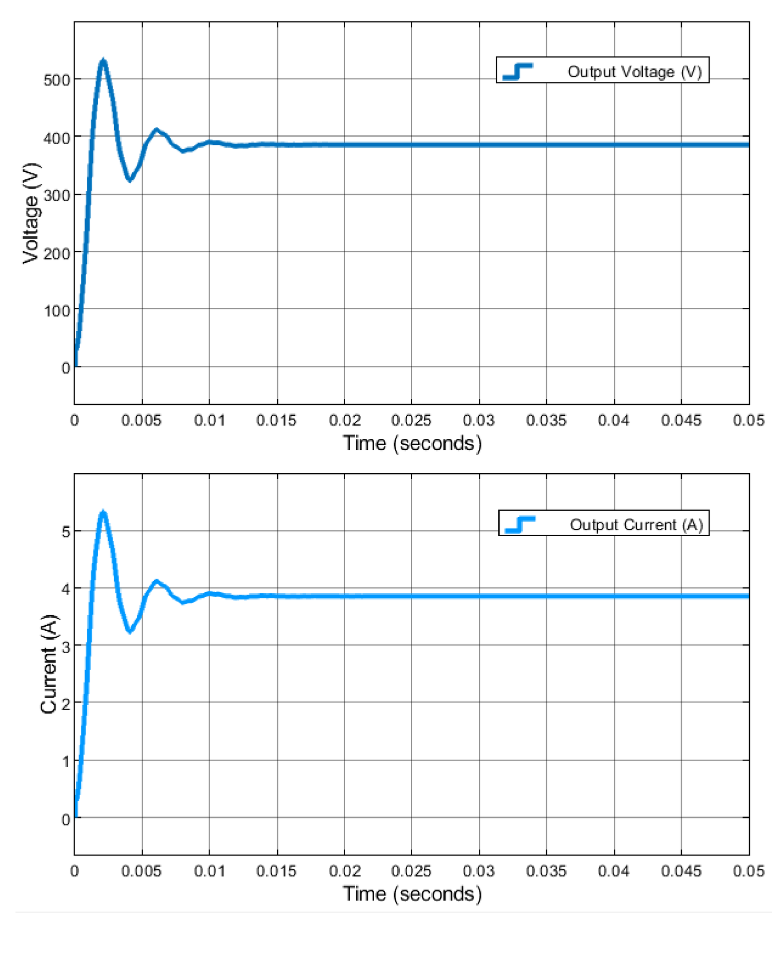

Fig.8 The output voltage and output current of the proposed topology.

Conclusion

The proposed topology can provide higher voltage gain with a reduced duty cycle for microinverter applications. It also has a simple structure. Due to the low voltage stresses on the active switches, active switches with low voltage ratings and low RDS(ON) can be chosen.

CPE2022:

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