Thermoelectric integral equations and algebraic approximation for thermoelectric power generator devices

Byungki Ryu[1,*], Jaywan Chung[1], and SuDong Park[1]

[1] *Korea Electrotechnology Research Institute (KERI), Changwon 51543, Republic of Korea*

Corresponding author (Electronic mail: byungkiryu@keri.re.kr)

A thermoelectric power generator device directly generates electrical power from thermal energy via thermoelectric effects. By solving temperature solution of the thermoelectric differential equations, thermoelectric energy conversion performances of the device can be predicted.

In this work, we transform thermoelectric differential equations into the thermoelectric integral equation for a one-dimensional thermoelectric generator device and derive the highly accurate thermoelectric algebraic form for heat currents at boundaries [1]. We find that thermoelectric efficiency is determined by three thermoelectric degrees of freedom (**DoF**s). Also, we find that the zero-current temperature solution is a good trial temperature solution for device parameters. Using 3 **DoF**s and device parameters, we successfully derive the approximate algebraic equations. At last, we test efficiency prediction accuracy using the ~300 published thermoelectric property data for single and multistage generators.

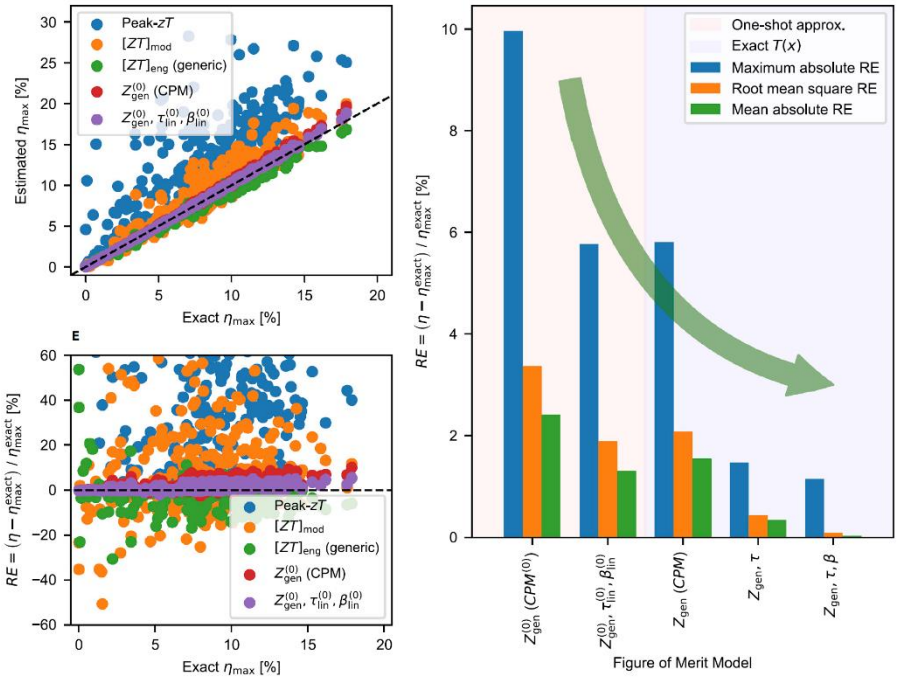

Figure 1 Efficiency prediction using integral formalism for 277 published materials [1]

Acknowledgments This work was supported by the KERI Primary research program of MSIT/NST of the Republic of Korea (No. 21A01003) and the KETEP/ MOTIE of the Republic of Korea (Nos. 20188550000290, 2021202080023D).

References

[1] B. Ryu et al., “Thermoelectric degrees of freedom determining thermoelectric efficiency,” *iScience*, 24, 102934 (2021).