GPPS | JOURNAL

JOURNAL OF THE GLOBAL POWER AND PROPULSION SOCIETY
journal.gpps.global

# Editorial: Some advances in additive manufacturing for aerothermal technologies

**Editorial**

**Article history:**
**Submission date:** 12 June 2023
**Acceptance date:** 18 June 2023
**Publication date:** 27 July 2023

Check for updates

***Correspondence:**
LH: li.he@eng.ox.ac.uk



**Keywords:**
additive manufacturing; aerothermal technology

**Citation:**
He L. (2023). Editorial: Some advances in additive manufacturing for aerothermal technologies. Journal of the Global Power and Propulsion Society, Special Issue: Some Advances in Additive Manufacturing for Aerothermal Technologies: 1–2.
https://doi.org/10.33737/jgpps/168474

Li He[1,*]

[1]*Department of Engineering Science, University of Oxford, Southwell Lab, OX2 0ES, Oxford, United Kingdom*

Additive Manufacturing (AM)/"3D Printing", has emerged in recent years as a major disruptive technology with the potential to make a profound impact on many industrial sectors and society in general. AM makes it possible to manufacture components of such complex geometries at such low cost and in such a short time scale, which would be extremely difficult or impossible with the traditional ("subtractive") manufacturing methods. The promise and appeal of AM have led to a rapid growth of the technology in the past two decades, and at an accelerated pace in recent years. For the aerospace industry, a speedy rise in AM is indicated by annual revenue growth from ~$2 billons in 2015 to ~$100 billons in 2035 (Najmon et al., 2019). AM has great potential for energy saving in manufacturing by reducing materials wastage and eliminating machining steps. It is projected that the widespread implementation of AM technologies would potentially lead to a reduction of the global energy demand by as much as 27% (Sun et al., 2021).

While showing great potential and growing at a very fast speed, additive manufacturing, as with any other new technology development, also faces many challenges. One can think of several typical questions when inquiring about the state of the art of AM development. What is the quality of AM-made parts (and pathways to improve it)? What is the potential of AM as indicated in a research environment? What is the impact of AM as demonstrated in practical industrial applications? As expected, the response to these questions would vary from one R&D and application area to another.

Against the general background of AM development, this special issue of the GPPS Journal was aimed at providing some pointers for AM development in the area of aerothermal technologies. The invited contributions are made by several well-established academic and industrial teams with extensive successful experiences in the related topic areas.

The contribution by Wildgoose and Thole of Penn State University (Wildgoose and Thole, 2023) deals with the key issue of AM printability in terms of variability of geometry and surface roughness of turbine cooling. Both simple channel and turbine blade configurations are considered based on extensive tests on the influence of AM model orientations and the build-locations. The case for a consistent characterization of the variability has been made, and the marked influence of the source-model distance is underlined.

The contribution by Xu, Cheng, and Jiang of Tsinghua University (Xu et al., 2023) gives an overview of some notable examples of recent progress in AM-assisted transpiration cooling. Performances of transpiration cooling setups for single-phase flow and new bionic ("self-pumping") configurations with phase change are discussed. The latter also serves as a good example of how AM can help create complex geometries for cooling performance enhancement, which would be very difficult to make if only conventional manufacturing methods are used.

The contribution by Kataoka, Tanigawa, Taneike, Ito, Komaki, and Motoyama of Mitsubishi Heavy Industries (Kataoka et al., 2023) presents the recent AM advances in a major company in the power generation sector. Examples showcase how AM can significantly speed up the prototyping of gas turbine combustor development, and how a new ring segment of complex geometry can be AM-made with the enhanced cooling performance as designed being confirmed in a real-world application. It also usefully illustrates how rapidly the number of delivered AM-made parts by the company has increased in the past 5 years or so.

We hope that the readers will find these articles informative and interesting, to stimulate further research, development, and applications of additive manufacturing for aerothermal technologies and beyond in academia and industries.

## Competing interests

Li He declares that he has no conflicts of interest.

## References

Kataoka M., Tanigawa S., Taneike M., Ito R., Komaki T., and Motoyama N. (2023). Development of metal AM technology for gas turbine components. Journal of the Global Power and Propulsion Society, Special Issue: Some Advances in Additive Manufacturing for Aerothermal Technologies. 49–65. https://doi.org/10.33737/jgpps/163429

Najmon J. C., Raeisi S., and Tovar A. (2019). Review of additive manufacturing technologies and applications in the aerospace Industry. Chapter 2. In: Additive Manufacturing for the Aerospace Industry, edited by Froes, F. and Boyer R.. Elsevier.

Sun C., Wang Y., McMurtrey M. D., Jerred N. D., Liou F., and Li J. (2021). Additive manufacturing for energy: a review. Applied Energy. 282: 116041.

Wildgoose A. J. and Thole K. A. (2023). Variability in additively manufactured turbine cooling features. Journal of the Global Power and Propulsion Society. Special Issue: Some Advances in Additive Manufacturing for Aerothermal Technologies. 3–18. https://doi.org/10.33737/jgpps/162654

Xu R. N., Cheng Z. L., and Jiang P. X. (2023). Fundamentals and recent progress of additive manufacturing-assisted porous materials on transpiration cooling. Journal of the Global Power and Propulsion Society, Special Issue: Some Advances in Additive Manufacturing for Aerothermal Technologies. 19–48. https://doi.org/10.33737/jgpps/166418