ISSN: 2320-5407

International Journal of Advanced Research

Publisher's Name: Jana Publication and Research LLP

www.journalijar.com

ISSN NO. 2320-5407

REVIEWER'S REPORT

Manuscript No.: **IJAR-53404** Date**: 19.08.2025**

Title: Numerical study of the effect of the magnetic field on magnetoconvective flow of a Newtonian fluid confined between two vertically offset hemispheres

Recommendation:
Accept after major revision .....

Rating	Excel.	Good	Fair	Poor
Originality			✓	
Techn. Quality			✓	
Clarity				✓
Significance			✓	

Reviewer Name: Dr.K.Arumuganainar **Date: 19.08.2025**

Reviewer's Comment for Publication.

Strengths of the Paper

- Clear numerical modeling framework.
- Consistent results aligned with established studies.
- Insightful visualizations of magnetoconvective flow.
- Strong coverage of magnetoconvection literature.

Weaknesses of the Paper

- Limited novelty claim and weak articulation of research gap.
- Validation restricted to one prior study.
- Repetition in discussion and abstract.
- Lack of practical application emphasis.

Detailed Reviewer's Report

Review Report

Title: Numerical study of the effect of the magnetic field on magnetoconvective flow of a Newtonian fluid confined between two vertically offset hemispheres.

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1. Title & Abstract

- **Strengths:**
  - The title is precise and technical, clearly reflecting the study's scope.
  - The abstract concisely explains the methodology (finite difference method in bispherical coordinates, FORTRAN code) and findings (effect of Hartmann number on convection and Nusselt number).
- **Weaknesses:**
  - The abstract is overly dense and could benefit from clearer segmentation (problem, methods, results, implications).
  - Some phrases are repetitive ("results show that magnetic field has an effect…").
- **Recommendation:** Simplify wording and highlight the novelty more clearly.

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2. Introduction

- **Strengths:**
  - Provides a strong background on magnetoconvection with broad applications (geophysics, astrophysics, medicine, etc.).
  - Well-referenced with a wide range of studies [1–21].
- **Weaknesses:**
  - The research gap is not explicitly highlighted—why this specific geometry (two eccentric hemispheres) is novel compared to prior works.
  - Flow between spheres and hemispheres has been studied before, so emphasis on the *unique contribution* is missing.

- **Recommendation:** Add a clear statement of novelty and research objectives.

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3. Literature Review

- **Strengths:**
  - Comprehensive, covering spherical, cylindrical, and other geometries.
  - Good linkage between convection, Rayleigh, and Hartmann numbers.
- **Weaknesses:**
  - Some references are outdated (1968, 1989, 1993), while more recent computational fluid dynamics studies could be included.
  - The integration of literature into a critical review is limited; the text feels more like a listing.
- **Recommendation:** Include recent papers (post-2020) on MHD convection in complex geometries and numerical simulation techniques.

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4. Methodology

- **Strengths:**
  - Clearly defined problem geometry and boundary conditions.
  - Well-structured mathematical modeling using bispherical coordinates.
  - Appropriate numerical methods (finite difference, ADI, SOR).
- **Weaknesses:**
  - Justification for grid size selection (51×51) is minimal, though tested.
  - Validation only against [20]—limited comparative analysis.
- **Recommendation:** Expand on grid independence testing, include additional validation cases, and discuss computational efficiency.

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5. Results & Discussion

- **Strengths:**

    - Results systematically presented: mesh/time step validation, Nusselt number comparison, effect of Hartmann number.
    - Visualization of isotherms and streamlines is clear and insightful.
    - Findings are consistent with physical expectations: low Ha → enhanced convection; high Ha → suppression of convection.
- **Weaknesses:**
    - Figures could be quantitatively compared to benchmark results rather than qualitatively described.
    - The discussion repeats conclusions (e.g., effect of low vs. high Hartmann numbers) without deeper physical explanation.
- **Recommendation:** Provide dimensionless correlations or scaling laws, and compare findings with experimental/numerical results in similar setups.

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6. Conclusion

- **Strengths:**
    - Summarizes key findings well: influence of Hartmann number on convection, Nusselt number, wall temperature.
    - Results consistent with literature.
- **Weaknesses:**
    - No mention of practical applications or implications (e.g., in engineering, astrophysics, or energy systems).
    - Lacks suggestions for future research directions.
- **Recommendation:** Include broader impact and propose extensions (e.g., turbulent regimes, nanofluids, 3D simulations).

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7. Language & Formatting

- **Strengths:**
    - Technical terminology is used correctly.
- **Weaknesses:**

    - Minor grammatical issues ("the results show that the magnetic field has an effect…" could be more precise).
    - Some long sentences reduce readability.
- **Recommendation:** Refine English expression, shorten long sentences, and follow a consistent journal style.

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8. Strengths of the Paper

- Clear numerical modeling framework.
- Consistent results aligned with established studies.
- Insightful visualizations of magnetoconvective flow.
- Strong coverage of magnetoconvection literature.

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9. Weaknesses of the Paper

- Limited novelty claim and weak articulation of research gap.
- Validation restricted to one prior study.
- Repetition in discussion and abstract.
- Lack of practical application emphasis.

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10. Final Recommendation

- **Decision: Major Revision**
- **Reasoning:** The paper is technically sound and presents a well-structured numerical analysis. However, improvements are needed in clarity of abstract, novelty justification, expanded validation, critical discussion, and highlighting real-world relevance. With revisions, it could be suitable for publication.