Review of "CFSpy: A Python Library for the Computation of Chen-Fliess Series"

Summary

This paper introduces CFSpy, a Python library for computing Chen-Fliess series and performing reachability analysis of nonlinear control-affine systems. The author details the mathematical foundations, numerical algorithms, and Python implementation of CFSpy, and demonstrates its application through simulations using a SEIRS epidemiological model and provides open-source implementations. The technical content is strong, and the work appears scientifically sound.

Written Quality

- The paper is well-written in English with generally clear prose but includes minor grammatical and syntactical errors (e.g., “rechable” → “reachable”, “has being” → “has been”)
- Some domain-specific jargon (e.g., "free monoid", "Hadamard product", “shuffle algebras”) could benefit from brief explanations for interdisciplinary or non-specialist readers
- Some sections (especially Definitions) are math-heavy and would benefit from added explanation or visual aids for accessibility to readers not deeply versed in control theory or formal languages.
- The narrative flows logically from theory to implementation to applications
- Tense and voice are generally consistent (though some passive constructions could be made active)

Technical Content

- The mathematical foundations appear sound and well-referenced
- The computational methods are clearly described with supporting algorithms
- The Python implementation demonstrates good software engineering practices
- The SEIRS model provides a convincing demonstration of the package's capabilities

Novelty and Impact

- The batch computation approach for iterated integrals appears novel
- The work advances both control theory (through computational methods) and scientific computing
- The open-source implementation makes this valuable to both researchers and practitioners

- The reachability analysis application has clear practical significance

Verifiability

- Algorithms are presented in sufficient detail for reproduction
- The paper references the Python implementation (though a DOI or permanent github repository link would strengthen this)
- The SEIRS example includes complete code snippets for reproducibility
- Data sources and parameters are clearly specified
- **Recommendation:** Include a link to the CFSpy package (e.g., GitHub or PyPI) if publicly available.

Other Requirements

- Software is properly cited (NumPy, SymPy, SciPy)
- Most acronyms are spelled out at first use. However, some acronyms (e.g., “CFS”) are not clearly spelled out at first use.
- Mathematical symbols are well-defined
- Figures have appropriate captions and are readable
- Code snippets follow PEP8 style and fit well in the layout
- **Recommendation:** Spell out acronyms and define symbols more consistently.

Suggestions for Improvement

1. Add a brief explanation of Chen-Fliess series' significance in the introduction for non-specialists
2. Consider adding a DOI or permanent repository link for the CFSpy package
3. The divergence of the series approximation at t=1.5s (Figure 1) could be briefly discussed
4. Consider adding a brief "Installation and Usage" subsection for practical adoption
5. **Grammar & Proofreading**: E.g., "rechable set" → "reachable set", "has being" → "has been", "performed" → "perform", etc.
6. **Acronyms & Definitions:** Spell out “CFS”, “MBB”, and “SEIRS” on first mention. Define all mathematical variables clearly in one place — perhaps as a table.

Overall Recommendation

This is a strong paper that meets all review criteria. The technical content is sound, the implementation is well-documented, and the work has clear scientific value. With minor improvements to accessibility for non-specialists and documentation permanence, I recommend acceptance. Minor issues with grammar, clarity, and reproducibility citation can be resolved easily.

Rating: Accept with minor revisions