Qeios

Peer Review

Review of: "Algorithmic Resilience Under Resource Constraints: The Novosibirsk School and the Method of Fractional Steps (1955–1975)"

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1. Independent researcher

This article offers a compelling historical analysis of Soviet numerical analysis during the Cold War, specifically focusing on the development of operator splitting methods at Novosibirsk. The thesis—that hardware constraints catalyzed algorithmic elegance—is persuasive and contributes valuable nuance to the historiography of computing. However, to meet publication standards in a peer-reviewed journal (e.g., IEEE Annals of the History of Computing or Historical Studies in the Natural Sciences), the manuscript requires stronger evidentiary support for industrial claims, correction of formatting errors, and clearer distinctions in mathematical terminology.

Major Revision Requests

1. Strengthen Evidence for Industrial Applications (Section 6.1)

a. Issue: Claims regarding the use of splitting methods for MiG-25/Su-27 aerodynamics are labeled as "historically probable" based on memoirs rather than primary computational reports.

b. Suggestion: Either downgrade the certainty of these claims in the text (e.g., use "alleged" or "anecdotal evidence suggests") or focus more heavily on the confirmed applications (atmospheric modeling/Marchuk). If retaining the aerospace claims, cite specific memoirs (e.g., Chertok [12]) with page numbers to allow verification. Avoid implying that full 3D CFD was routine on BESM-6 without qualifying the severe limitations.

2. Clarify "Fractional" Terminology (Critical for Technical Accuracy)

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a. Issue: The term "Fractional Steps" (operator splitting) is distinct from "Fractional Calculus" (non-integer derivatives, e.g., Caputo derivatives). Given contemporary research activity in Fractional Calculus (see related manuscript 1801632 in this session), confusion may arise for readers unfamiliar with Soviet numerical terminology.
b. Suggestion: Add a brief footnote or parenthetical clarification in the Introduction defining "Fractional Steps" as operator splitting (dróbnykh shagov) to distinguish it from fractional derivatives. This prevents conceptual conflation for modern computational physicists.

3. Nuance the West vs. Soviet Comparison (Table 2)

a. Issue: Table 2 implies Western ADI focused solely on accuracy while Soviets focused on economy. Western industrial R&D (e.g., oil reservoir simulation) was also heavily driven by computational cost.
b. Suggestion: Refine the distinction to emphasize theoretical formalization vs. heuristic application. The Soviet contribution was arguably more about embedding the method into a unified operator theory framework, whereas Western development was often more problem-specific.

4. Expand on Archival Limitations (Section 7)

a. Issue: The author acknowledges archival gaps but could propose more concrete mitigation strategies.
b. Suggestion: Recommend specific oral history projects (e.g., interviewing surviving members of the Sobolev Institute or Computing Centre) as a concrete future research direction to fill the "invisible labor" gap mentioned in Section 5.4.

Component	Assessment	Comments
Historical Accuracy	⚠️ Mostly Valid	Core timeline (Yanenko 1967, Peaceman 1955) is accurate. Industrial claims need stronger sourcing.
Technical Explanation	✅ Valid	Explanation of ADI/Splitting and Progonka is correct and accessible.
Argumentation	✅ Strong	The link between memory constraints and algorithmic choice is well-supported by hardware specs.
Formatting	❌ Needs Work	Significant encoding errors must be fixed before publication.

Attachments: available at https://doi.org/10.32388/NFRHNN

Declarations

Potential competing interests: I am not conflict interest