MATHAUDIT / DETAILED REPORT

Correctness, proof completeness, and novelty audit

Dirichlet improvability in L_p-norms

Nikolay Moshchevitin, Nikita Shulga

Paper	arXiv:2408.06200v3
Source version	Submitted 22 June, 2026; v1 submitted 12 August, 2024; announced August 2024.
Audit date	August 15, 2026
Prompt	Standardized prompt
Novelty cutoff	August 12, 2024
Paper license	CC BY 4.0
Scope	Statements, proofs, and novelty only

Important limitation. AI-generated analysis. This report is not a correctness certificate or a substitute for expert scrutiny. A Correct status may coexist with yellow typos or minor formal corrections that do not affect substantive soundness. It means that this audit found no unresolved substantive error under the stated criteria; it is not formal verification and should remain open to expert challenge and correction.

SUMMARY

01	Statements	Contains unsupported statements
02	Proofs	Contains unverified proofs
03	Novelty	No non-novelty findings

01 / STATEMENTS

Statements

Contains unsupported statements

The continued-fraction classification and the Hausdorff-dimension consequences are internally coherent conditional on the asserted classification of critical lattices for L_p balls. For $1 < p < 6$, $p \neq 2$, that material input rests on a computer-assisted verification whose decisive formulas and certificate are not contained in a fixed reviewed artifact, so the full all-p statements are not able to be verified from the available evidence. No counterexample to any stated theorem was found.

Theorem 3.1: The all-p classification depends on an unverified computer-assisted input

Pages 8–10 and 14–20 · Theorem 3.1 and Sections 5–6 · arXiv:2408.06200v3

Not able to verify

The theorem classifies $\mathbf{DI}_p^c$ for every $p \in [1, \infty)$ by first identifying every critical lattice of the L_p unit ball. The manuscript itself records that the published proof of this critical-lattice classification contains false derivative-sign assertions, and Appendix A replaces it, for $1 < p < 6$ and $p \neq 2$, by interval computations. The unresolved obligation is the uniform inequality

$$\Delta(p, \sigma) > \min\{\Delta(p, 1), \Delta(p, \sigma_p)\}$$

throughout that full two-parameter region. Appendix A supplies tables and three pieces of pseudocode, but omits several analytic derivative expressions, refers those expressions to mutable external code, gives no fixed commit or independently checkable output certificate, and describes the fuller verification as work in preparation. I was therefore unable to verify the critical-lattice input in these regimes. The classical $p = 1, 2$ descriptions and the cited analytic range $p \geq 6$ are not affected by this finding, and no evidence that the classification is false was found.

Verifiable source: Computer-assisted verification repository cited as reference 43

Theorem 1.1: The full parameter-range dimension conclusion inherits the unresolved input

Page 4 · Theorem 1.1; pages 24–25 · its proof · arXiv:2408.06200v3

Not able to verify

Theorem 1.1 claims $\dim_H(\mathbf{DI}_p \setminus \mathbf{BA}) = 1$ for every finite $p \geq 1$. Its sparse-insertion argument and dimension-preservation lemma support the conclusion once Theorem 3.1 is available. However, the proof explicitly invokes Theorem 3.1 to decide which inserted continued-fraction patterns are excluded or forced. Thus the all-p portion of Theorem 1.1 is not independently verified in the same regimes as the preceding finding. Theorem 1.2 uses only the classical $p = 1, 2$ critical loci and is supported by the internal argument, so no adverse conclusion is drawn about it.

Verifiable source: Full paper, version 3

02 / PROOFS

Proofs

Contains unverified proofs

The compactness-to-pattern reduction and the sparse-insertion dimension arguments are verifiable, conditional on the critical-lattice classification. The interval-arithmetic replacement for the flawed historical proof is not fully auditable from the paper and its unpinned external code, leaving a precise foundational proof obligation unresolved rather than disproved.

Appendix A: The interval verification is not self-contained or fixed to a reproducible certificate

Pages 33–45 · Appendix A and Appendix B · arXiv:2408.06200v3

Not able to verify

The appendix correctly isolates the needed inequality and partitions the domain into explicit numerical boxes, but Remark A.3 withholds the full formulas for several differentiated functions, Tables 1–4 report claimed checks rather than enclosing intervals or machine-verifiable certificates, and the cited repository is not pinned to a commit. This prevents checking that the implemented expressions equal the mathematical derivatives, that every branch of the implicitly defined $\tau(p, \sigma)$ is enclosed, and that every box in the open region is covered without overlap gaps. These are concrete nontrivial obligations because the paper documents counterexamples to corresponding sign assertions in references 13–14. Repair classification: provide a fixed source archive and environment, complete formulas or generated-expression hashes, certified run logs covering every listed box, and a coverage proof tying the boxes to Equation (57).

Verifiable source: Full paper, version 3

Proposition 4.1 and proof of Theorem 3.1: The compactness and continued-fraction reduction is correct conditional on the critical locus

Pages 12–20 · Proposition 4.1, Lemma 6.1, and proof of Theorem 3.1 · arXiv:2408.06200v3

Correct and complete

Mahler compactness converts equality in the Dirichlet bound into accumulation on the normalized critical locus. In each listed critical-lattice type, the two distinguished lattice vectors become consecutive best-approximation vectors by Lemma 6.1; the ratios in Equation (7) then force exactly the finite, rational-tail, or infinite palindromic patterns stated in Theorem 3.1. Conversely, a sequence of such patterns fixes both basis-vector ratios and, after determinant normalization, produces the required critical-lattice accumulation point. This part of the proof introduces no additional defect beyond the availability of the complete critical locus itself.

Lemma 9.1 and Sections 8–10: The dimension-preserving insertion arguments are correct

Pages 21–32 · Lemma 8.1, Lemma 9.1, and proofs of Theorems 1.1–1.2 · arXiv:2408.06200v3

Correct and complete

The inserted symbols have density $\omega(n) = o(n^{1-\varepsilon_1})$, while condition (2) bounds their size polynomially. Continuant estimates therefore make deletion locally $1/(1+\varepsilon)$-Hölder and insertion locally Lipschitz on every bounded-partial-quotient stratum. Taking the countable union over those strata preserves Hausdorff dimension. The chosen sparse words then either force or avoid the required critical patterns, and their unbounded entries exclude bad approximability.

The $p = 1, 2$ comparison in Theorem 1.2 is consequently verified independently of the computer-assisted nonclassical critical loci.

03 / NOVELTY

Novelty

No non-novelty findings

No non-novelty findings.

METHOD

Scope and decision rules

This audit addressed only the correctness of central statements, the correctness and completeness of proofs, and evidence-backed non-novelty. It did not evaluate importance, exposition, style, suitability for publication, or author reputation.

An adverse finding is included only where the report can give a direct calculation, counterexample, formal contradiction, or a verifiable source establishing the precise claim. An inability to verify is kept distinct from a demonstrated defect. Technical compression is not treated as incompleteness when the omitted reasoning is recoverable and correct.

Before any finding was recorded, the argument was closed under immediate, mechanically checkable consequences of facts already established. An observation was suppressed when the printed conclusion followed by elementary logic, direct substitution, weakening, inclusion, or verified monotonicity and no substantive proof obligation or textual correction remained.

Typographical errors and minor formal corrections remain fully visible in yellow with their locations and repairs. When such a defect is unambiguous, local, and harmless to the paper's substantive conclusions, it does not lower the overall statements or proofs status from Correct.

The novelty panel reports only central results for which a verifiable primary source predating the earliest public version that contains the result proves the same statement up to notation, or from which the statement follows directly and immediately. It contains no positive novelty certifications and no entries based merely on an unsuccessful literature search.

All mathematical expressions in this report are compiled by LaTeX. The web presentation independently validates and renders the corresponding expressions with KaTeX.

Sources checked

1. Full paper, version 3

2. Computer-assisted verification repository cited as reference 43

arXiv acknowledgement

Thank you to arXiv for use of its open access interoperability. This service was not reviewed or approved by, nor does it necessarily express or reflect the policies or opinions of, arXiv.

APPENDIX

Standardized prompt

You are a mathematical auditor. Evaluate only the correctness of the paper's central statements, the correctness and completeness of its proofs, and evidence-backed non-novelty. Do not make editorial comments or evaluate importance, exposition, style, or suitability for publication. Keep the report neutral, precise, and professional.

PART 1 — CORRECTNESS OF THE MAIN STATEMENTS

Identify the paper's central statements and assess each one separately using exactly one of these outcomes:

- *Correct: the statement has a correct, verifiable proof; or, despite a defect in the printed proof, you can give a fully verified repair or independent proof.*
- *Incorrect: you can give strong formal evidence that the statement as written is false, preferably a counterexample or a complete contradiction.*
- *Not able to verify: the supplied proof does not establish the statement, and you can neither supply a fully verified proof nor disprove it.*

For every adverse or unverified outcome, restate the exact claim and hypotheses, identify its location in the reviewed version, and give the decisive reasoning. Do not infer that a theorem is false merely because its printed proof is defective.

Assign the overall statements status by the following priority:

1. *Contains wrong statements, if at least one central statement is Incorrect.*
2. *Contains unsupported statements, if no central statement is Incorrect but at least one is Not able to verify.*
3. *Correct, if every central statement is Correct, apart from any typographical or minor formal findings allowed by Part 4.*

PART 2 — CORRECTNESS AND COMPLETENESS OF THE PROOFS

Audit the proofs of the central statements and every material internal or cited input on which they depend. For each proof or proof segment, use the narrowest supported outcome:

- *Correct and complete: every substantive step is verifiable and no case or crucial nontrivial step is missing.*
- *Incorrect as written: a displayed calculation, inference, lemma, or cited application is formally false or inapplicable.*
- *Incomplete as written: a necessary substantive step or case is missing, even though no explicit contradiction has been proved.*
- *Not able to verify: the available paper and sources are insufficient to decide whether the step is valid.*

Do not flag omitted routine details, compressed arguments, or "analogously" steps when the omitted reasoning is recoverable and correct. For every defect, identify its smallest exact location, explain its downstream dependency, and classify any proposed repair as one of:

- *Verified repair: supply enough reasoning to verify that the repair works throughout every affected use.*
- *Plausible repair only: describe the possible repair but do not treat it as established.*
- *No repair supplied.*

Assign the overall proofs status by the following priority:

1. *Contains incorrect or incomplete proofs, if at least one proof is Incorrect as written or Incomplete as written.*
2. *Contains unverified proofs, if there is no proved incorrectness or incompleteness but at least one material proof is Not able to verify.*
3. *Correct, if all audited proofs are Correct and complete, apart from any typographical or minor formal findings allowed by Part 4.*

PART 3 — NOVELTY OF THE MAIN STATEMENTS

This is a one-sided, evidence-only check. Evaluate only central results. Report a result only when a verifiable primary source, publicly available before the earliest public version of the paper that contains the result, proves the same statement up to a change of notation, or when the result follows directly and immediately from such an earlier theorem.

For each non-novelty finding, provide the earlier source, its public date, the exact theorem or proposition, and an explicit hypothesis-and-conclusion mapping. A later source cannot establish non-novelty. Do not flag a result merely because an easier proof exists or because it follows through a nontrivial argument. Do not flag a result that the paper itself explicitly presents as known, a survey item, or an alternative proof.

Mention only statements that meet this non-novelty threshold. Say nothing about statements for which no such evidence was found: do not certify novelty, list unsuccessful searches, or add statement-level "no prior source found" entries. If the list is empty, the section may say only "No non-novelty findings."

PART 4 — TECHNICAL AND EVIDENTIARY RULES

1. Criticism must never be overstated. Call a statement incorrect, a proof incorrect or incomplete, or a result non-new only when strong formal evidence supports that exact judgment. Otherwise use Not able to verify where that outcome exists, or remain silent in the novelty section.

2. Review a specified paper version. Give exact page, theorem, equation, or proof locations; restate relevant quantifiers and hypotheses; and check domains, endpoints, parameter ranges, constants, and dependencies explicitly. Apply a defect only to the regimes and downstream results that actually depend on it.

3. Immediate-consequence closure: when deciding whether a conclusion is supported, treat the argument as including every immediate formal consequence of facts established earlier in the paper and available at that point. An immediate formal consequence is a local, mechanically checkable inference using only definitions already in force, elementary logic, direct substitution or renaming, weakening of an inequality or set inclusion, or a monotonicity or symmetry property explicit in a definition or already proved.

4. Such an inference must introduce no new lemma, estimate, construction, case analysis, limiting or compactness argument, external result, or new issue of uniformity or parameter dependence. Check the direction of monotonicity and the dependence of every threshold or constant explicitly. Do not exchange pointwise and uniform conclusions, change exceptional sets, interchange quantifiers or limits, or extend an endpoint under this rule unless the required fact was already established.

5. If the claimed conclusion follows after immediate-consequence closure, it is fully supported. Do not report a gap, unsupported statement, minor formal correction, or recommendation to add an explanatory sentence, and do not mention the suppressed item in the report. This suppression does not apply to a genuine typographical error as defined below, because a typo is a literal notation defect that still requires a textual correction. For example, if $P(delta)$ is proved for every sufficiently small delta > 0 and P is immediately monotone in the required direction, then the claim that $P(delta)$ holds for every delta > 0 requires no correction; the omitted monotonicity step is exposition rather than an audit finding.

6. Immediate-consequence closure permits reconstruction of an omitted inference; it does not permit silent alteration of the printed domain, hypotheses, or quantifiers of an intermediate statement later invoked outside its stated scope. If formal validity requires changing the text of that statement or its stated range, report the appropriate finding even when the repair is easy. Thus a result stated only for $t > 0$ and subsequently applied at $t = 0$ remains a formal scope mismatch unless the endpoint case was separately established before the application.

7. Apply this mandatory gate before recording any adverse, unverified, typographical, or minor formal finding: (a) identify the exact assertion or inference alleged to be defective; (b) reconstruct the strongest conclusion following from the preceding argument after all admissible immediate formal consequences are added; (c) identify the specific defect that remains — a formally demonstrated falsehood, a concrete nontrivial unresolved proof obligation, or a genuine domain, hypothesis, quantifier, or notation mismatch requiring a textual correction; and (d) state the evidence and minimal repair. If no specific defect remains, or if the only possible addition would be explanatory, suppress the finding entirely. Use Not able to verify only when a precise, nontrivial unresolved obligation can be identified.

8. A typographical error is an incorrect symbol, index, exponent, sign, variable name, or notation mismatch whose unique intended correction is mechanically determined from the surrounding text and does not alter the mathematical argument. Report it in yellow as Typo, with the printed text, correction, exact location, and reason it is harmless. It does not lower an overall status.

9. A minor formal correction is a boundary, endpoint, or displayed parameter-range defect that can be repaired consistently in every affected statement by a local change, without a new argument, without invalidating any related result or application, and without creating another substantive defect. Report it in yellow as Minor formal correction, with the same details. It does not lower an overall status.

10. Do not use either minor category if more than one materially different repair is possible; if the repair changes the substance or scope of a central result; if an excluded case is used later; if the correction fails to propagate consistently; or if a new mathematical idea is required. In such cases use the strongest substantive classification actually supported by evidence.

11. Write every mathematical expression as valid, compilable LaTeX. Use ... for inline mathematics and

...

for displayed mathematics, with balanced delimiters and braces. Do not leave raw LaTeX commands outside math delimiters.

12. Separate theorem truth from the correctness of the printed proof. A theorem can be Correct in Part 1 because of a fully verified independent proof while its printed proof is adverse in Part 2. Conversely, a defective proof alone never licenses an Incorrect theorem classification.

Organize the report under Parts 1–3 and apply Part 4 throughout. Do not add editorial commentary, scores, rankings, recommendations, or a list of suppressed observations.

END OF REPORT

Each claim in this prototype report remains open to independent challenge and revision.