

ON GEOMETRICAL PROPERTIES OF STARLIKE LOGHARMONIC MAPPINGS

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Abstract. In this paper, we find the radius of the disk Ω_r such that every starlike logharmonic mapping $f(z)$ of order α , is starlike in $|z| \leq r$ with respect to any point of Ω_r . We also establish a relation between the set of starlike logharmonic mappings and the set of starlike logharmonic mappings of order α . Moreover, the radius of starlikeness and univalence for the set of close to starlike logharmonic mappings of order α is determined.

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REFERENCES

- [1] Z. ABDULHADI AND R. M. ALI, *Univalent logharmonic mappings in the plane*, Abstr. Appl. Anal. **2012**, Art. ID 721943, pp. 1–32.
- [2] Z. ABDULHADI, *Close-to-starlike logharmonic mappings*, Internat. J. Math. Math. Sci. **19** (1996), no. 3, 563–574.
- [3] Z. ABDULHADI, *Typically real logharmonic mappings*, Int. J. Math. Math. Sci. **31** (2002), no. 1, 1–9.
- [4] Z. ABDULHADI AND Y. ABUMUHANNA, *Starlike logharmonic mappings of order alpha*, Journal of Inequalities in Pure and Applied Mathematics **7** (4) Art. 123, (2006), 1–6.
- [5] Z. ABDULHADI AND D. BSHOUTY, *Univalent functions in $H \cdot \overline{H}(D)$* , Trans. Amer. Math. Soc. **305** (1988), no. 2, 841–849.
- [6] Z. ABDULHADI AND W. HENGARTNER, *Spirallike logharmonic mappings*, Complex Variables Theory Appl. **9** (1987), no. 2–3, 121–130.
- [7] Z. ABDULHADI, W. HENGARTNER AND J. SZYNAL, *Univalent logharmonic ring mappings*, Proc. Amer. Math. Soc. **119** (1993), no. 3, 735–745.
- [8] Z. ABDULHADI AND W. HENGARTNER, *One pointed univalent logharmonic mappings*, J. Math. Anal. Appl. **203** (1996), no. 2, 333–351.
- [9] Z. ABDULHADI AND W. HENGARTNER, *Polynomials in $H\overline{H}$* , Complex Variables Theory Appl. **46** (2001), no. 2, 89–107.
- [10] Y. ABU-MUHANNA AND A. LYZZAIK, *The boundary behaviour of harmonic univalent maps*, Pacific J. Math. **141** (1990), no. 1, 1–20.
- [11] M. AYDOGAN, *Some results on a starlike log-harmonic mapping of order alpha*, J. Comput. Appl. Math. **256** (2014), 77–82.
- [12] M. AYDOGAN AND Y. POLATOĞLU, *A certain class of starlike log-harmonic mappings*, J. Comput. Appl. Math. **270** (2014), 506–509.
- [13] X. CHEN AND T. QIAN, *Non-stretch mappings for a sharp estimate of the Beurling-Ahlfors operator*, J. Math. Anal. Appl. **412** (2014), no. 2, 805–815.
- [14] J. CLUNIE AND T. SHEIL-SMALL, *Harmonic univalent functions*, Ann. Acad. Sci. Fenn. Ser. A I Math. **9** (1984), 3–25.
- [15] P. L. DUREN, *Univalent functions*, Grundlehren der Mathematischen Wissenschaften **259**, Springer, New York, 1983.
- [16] P. DUREN AND G. SCHOBER, *A variational method for harmonic mappings onto convex regions*, Complex Variables Theory Appl. **9** (1987), no. 2–3, 153–168.

- [17] P. DUREN AND G. SCHOBER, *Linear extremal problems for harmonic mappings of the disk*, Proc. Amer. Math. Soc. **106** (1989), no. 4, 967–973.
- [18] W. HENGARTNER AND G. SCHOBER, *On the boundary behavior of orientation-preserving harmonic mappings*, Complex Variables Theory Appl. **5** (1986), no. 2–4, 197–208.
- [19] W. HENGARTNER AND G. SCHOBER, *Harmonic mappings with given dilatation*, J. London Math. Soc. (2) **33** (1986), no. 3, 473–483.
- [20] S. H. JUN, *Univalent harmonic mappings on $\Delta = \{z : |z| > 1\}$* , Proc. Amer. Math. Soc. **119** (1993), no. 1, 109–114.
- [21] P. LI, S. PONNUSAMY AND X. WANG, *Some properties of planar p -harmonic and $\log p$ -harmonic mappings*, Bull. Malays. Math. Sci. Soc. (2) **36** (2013), no. 3, 595–609.
- [22] ZH. MAO, S. PONNUSAMY, AND X. WANG, *Schwarzian derivative and Landau's theorem for logharmonic mappings*, Complex Var. Elliptic Equ. **58** (2013), no. 8, 1093–1107.
- [23] Z. NEHARI, *The elliptic modular function and a class of analytic functions first considered by Hurwitz*, Amer. J. Math. **69** (1947), 70–86.
- [24] J. C. C. NITSCHE, *Lectures on minimal surfaces*, vol. 1, translated from the German by Jerry M. Feinberg, Cambridge Univ. Press, Cambridge, 1989.
- [25] R. OSSERMAN, *A survey of minimal surfaces*, second edition, Dover, New York, 1986.
- [26] H. E. ÖZKAN AND Y. POLATOĞLU, *Bounded log-harmonic functions with positive real part*, J. Math. Anal. Appl. **399** (2013), no. 1, 418–421.