

## SOME PROPERTIES ABOUT COMPLEX DIFFERENCE EQUATIONS OF MALMQUIST TYPE

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*Abstract.* This article presents versions of the Malmquist type equation. We study the growth of transcendental meromorphic solutions of some complex  $(qz + c)$  difference equations and find lower bounds for Nevanlinna lower order for meromorphic solutions of such equations. We also obtain a  $(qz + c)$  difference version of Tumura-Clunie theorem, which improves the results of Zheng and Chen[25].

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### REFERENCES

- [1] M. J. ABLowitz, R. G. HALBURD, B. HERBST, *On the extension of the Painlevé property to difference equations*, Nonlinearly, **13**, (2000), 889–905.
- [2] D. BARNETT, R. G. HALBURD, R. J. KORHONEN, W. MORGAN, *Nevanlinna theory for the  $q$ -difference equations*, Proc. Roy. Soc. Edinburgh Sect. **137**, (2007), 457–474.
- [3] W. BERGWELER, K. ISHIZAKI, N. YANAGIHARA, *Meromorphic solutions of some functional equations*, Methods Appl. Anal. **5**, 3 (1998), 248–259.
- [4] W. BERGWELER, J. K. LANGLEY, *Zeros of differences of meromorphic solutions*, Math. Proc. Cambridge Philos. Soc. **142**, (2007), 133–147.
- [5] Y. M. CHIANG, S. J. FENG, *On the Nevanlinna characteristic of  $f(z + \eta)$  and difference equations in the complex plane*, Ramanujan J. **16**, (2008), 105–129.
- [6] Z. X. CHEN, K. H. SHON, *On zeros and fixed points of differences of meromorphic functions*, J. Math. Anal. Appl. **344**, 1 (2008), 373–383.
- [7] J. CLUNIE, *On integral and meromorphic functions*, J. London Math. Soc. **37**, (1962) 17–27.
- [8] V. I. GROMAK, I. LAINE, S. SHIMOMURA, *Painlevé Differential equations in the Complex Plane*, Walter de Gruyter, Berlin, 2002.
- [9] G. GUDERSEN, J. HEITOKANGAS, I. LAINE, J. RIEPPO, D. YANG, *Meromorphic solutions of generalized Schröder equation*, Aequationes Math. **63**, (2002), 110–135.
- [10] R. GOLDSTEIN, *Some results on factorisation of meromorphic functions*, J. London Math. Soc. **4**, 2 (1971), 357–364.
- [11] R. GOLDSTEIN, *On meromorphic solutions of certain functional equations*, Aequationes Math. **18**, (1978), 112–157.
- [12] R. G. HALBURD, R. J. KORHONEN, *Existence of finite-order meromorphic solutions as a detector of integrability in difference equation*, Phys. D **218**, (2006), 191–203.
- [13] R. G. HALBURD, R. J. KORHONEN, *Nevanlinna theory for the difference operator*, Ann. Acad. Sci. Fenn. Math. **31**, (2006), 463–478.
- [14] W. K. HAYMAN, *Meromorphic Functions*, Clarendon Press, Oxford, (1964).
- [15] W. K. HAYMAN, *On the characteristic of functions meromorphic in the plane and of their integrals*, Proc. London math. Soc. **3**, (1963), 93–128.
- [16] J. HEITOKANGAS, R. J. KORHONEN, I. LAINE, J. RIEPPO, K. TOHGE, *Complex difference equations of Malmquist type*, Comput. Methods Funct Theory **1**, (2001), 27–39.

- [17] K. ISHIZAKI, *Hypertranscendence of meromorphic solutions of a linear functional equation*, Aequationes Math. **56**, (1998), 271–283.
- [18] I. LAINE, *Nevanlinna Theory and Complex Differential Equations*, Walter de Gruyter, Berlin, (1993).
- [19] I. LAINE, J. RIEPPO, H. SILVENNOINEN, *Remarks on complex difference equations*, Comput. Methods Funct. Theory **5**, 1 (2005), 77–88.
- [20] R. NEVANLINNA, *Analytic Function*, Springer-Verlag. Berlin/ Heidelberg/ New York, (1970).
- [21] A. RAMANI, B. GRAMMATICOS, T. TAMIZHMANI, K. M. TAMIZHMANI, *The road to the discrete analogue of the Painlevé property: Nevanlinna meets singularity confinement*, Comput. Math. Appl. **45**, (2003), 1001–1012.
- [22] Y. TUMURA, *On the extensions of Borel's theorem and Saxer-Csillag's theorem*, Proc. Phys. Math. Soc. Japan **19**, (1937), 29–35.
- [23] G. WEISSENBORN, *On the theorem of Tumura and Clunie*, Bull. London Math. Soc. **18**, (1986), 371–373.
- [24] J. WANG, *Growth and poles of meromorphic solutions of some complex difference equations*, J. Math. Anal. Appl. **379**, (2011), 367–377.
- [25] X. M. ZHENG, Z. X. CHEN, *Some properties of meromorphic solutions of  $q$ -difference equations*, J. Math. Anal. Appl. **361**, (2010), 472–480.
- [26] K. LIU, T. B. CAO, *Entire solutions of Fermat type  $q$ -difference differential equations*, Electron. J. Differential Equations **59**, (2013), 1–10.
- [27] Z. B. HUANG, R. R. ZHANG, *Properties on  $q$ -difference Riccati equations*, Bull. Korean. Math. Soc. **55**, (2018), 1755–1771.