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Meromorphic solutions of higher order algebraic differential equations

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First part concerns pointwise growth estimates for the spherical derivative of solutions of the N-th order algebraic differential equation

$$\left(f^{(N)}\right)^n + \sum_{k=1}^{n} P_{k,N}(f)\left(f^{(N)}\right)^{n-k} = 0, \tag{1}$$

where

$$P_{k,N}(f) = \sum_{j_0=0}^{m_{k,0}} \sum_{j_1=0}^{m_{k,1}} \cdots \sum_{j_{N-1}=0}^{m_{k,N-1}} a_{k,j_0,\dots,j_{N-1}} \prod_{\ell=0}^{N-1} \left(f^{(\ell)}\right)^{j_\ell}, \quad k = 1, \dots, n,$$

with $a_{k,j_0,\dots,j_{N-1}}$ are analytic functions in the unit disk $\mathbb{D}$ and $m_{k,j} \in \mathbb{N} \cup \{0\}$ for all $j = 0, \dots, N-1$ and $k = 1, \dots, n$. The case $N = 1$ reduces to the first order equation

$$(f')^n + \sum_{k=1}^{n} P_k(f)\,(f')^{n-k} = 0,$$

Methods of estimate the spherical derivative of meromorphic solutions of (1) were based on the Lohwater-Pommerenke re-scaling method. In that case we assume that a solution is not a normal function. Our approach allows to obtain a pointwise estimate for the spherical derivative of m-th power of a solution for some integer m. The question arises when for a given class X of meromorphic functions in the unit disk $\mathbb{D}$ and $m \in \mathbb{N} \setminus \{1\}$, $f^m \in X$ implies $f \in X$. In some cases, the answer may be affirmative. We will consider some classes of meromorphic functions that already include normal functions, and the Lovater-Pommerenke method is inapplicable in these cases. This is the second part of the talk.

The talk was prepared in collaboration with Prof. Jouni Rättyä and Mr. Tony Vesikko.