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Bernstein Type of Inequality for Rational Functions with Prescribed Poles

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ABSTRACT. Let $P(z)$ be a polynomial of degree not exceeding n and let $W(z) = \prod_{j=1}^{n}(z - z_j)$ where $|z_j| > 1, j = 1, 2, ..., n$. If the rational function $r(z) = \frac{P(z)}{W(z)}$ does not vanish in $|z| < k$, then for $k = 1$ it is known that

$$r'(z) \leq \frac{1}{2}|B'(z)| \sup_{|z|=1} |r(z)| \quad \text{where} \quad B(z) = \frac{W*(z)}{W(z)} and W*(z) = z^n \overline{W\left(\frac{1}{\bar{z}}\right)}$$

and for $k > 1$,

$$\sup_{|z|=1} \left\{ \left|\frac{r'(z)}{B'(z)}\right| + \left|\frac{(r*(z))'}{B'(z)}\right| \right\} = \sup_{|z|=1} |r(z)| \quad \text{where} \quad r*(z) = B(z)\overline{r\left(\frac{1}{\bar{z}}\right)}$$

In this paper we shall consider the moduli of all the zeros of $r(z)$ instead of maximum modulus of zeros of $r(z)$ and present a refinement of some results.

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