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ANALYSIS OF STAGNATION POINT FLOW OVER A STRETCHING/SHRINKING SURFACE

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Abstract. In this article we analyze the boundary value problem governing stagnation-point flow of a fluid with a power law outer flow over a surface moving with a speed proportional to the outer flow. The flow is characterized by two physical parameters; ε, which measures the stretching ($\varepsilon > 0$) or shrinking ($\varepsilon < 0$) of the sheet relative to the outer flow, and $n > 0$, the power law exponent. In the case of aiding flow ($\varepsilon > 0$), where the (stretching) surface and the outer flow move in the same direction, we prove existence of a solution for all values of n. For opposing flow ($\varepsilon < 0$), where the (shrinking) surface and the outer flow move in opposite directions, the situation is much more complicated. For $-1 < \varepsilon < 0$ and all n we prove a solution exists. However, for $\varepsilon \leqslant -1$, we prove there exists a value, $\varepsilon_{crit}(n) \leqslant -1$, such that no solutions exist for $\varepsilon \leqslant \varepsilon_{crit}$. For $n = 1/7$ and $n = 1/3$ we prove that $\varepsilon_{crit} = -1$. For other values of n, we derive bounds which illustrate the complicated nature of the existence/nonexistence boundary for opposing ($\varepsilon < 0$) flows.

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