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Analysis and reduction of skin-friction in a rocket-based combined-cycle engine flow path operating from Mach 1.5 to 6.0

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# 1            **Analysis and Reduction of Skin-Friction in a** 2            **Rocket-Based Combined-Cycle Engine Flow Path** 3            **Operating from Mach 1.5 to 6.0**

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## 8            **Abstract**

9            The skin-friction in a rocket-based combined-cycle engine operating from Mach 1.5 to 6.0 was  
10          analyzed in the present study. The friction proportion of different parts of the engine was  
11          investigated to offer a reference for the rearrangement of skin-friction reduction in the engine. The  
12          distribution and variation trend of the skin-friction in the flow path as well as its impacts on the  
13          engine performance were numerically compared. At three typical flight points, i.e. at 1.8Ma, 3.0Ma  
14          and 6.0Ma, the change of the skin-friction with attack angle was studied. A special focus was placed  
15          on the reduction of the skin-friction by using boundary layer combustion. It was modeled when the  
16          airstream flowed into the engine at the speed of 6 Ma. The method of hydrogen combustion in boundary  
17          layer has achieved 57.7% skin-friction reduction effect.

18  
19          **Key Words:** Wide Operation Range Rocket-Based Combined-Cycle; Variable Attack Angle; Wall  
20          Shear Stress; Boundary Layer Combustion; Skin-Friction Reduction

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