Stagnation point computations of non equilibrium inviscid blunt body flow

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Dedicated to E. Krause on the occasion of his 60-th birthday. The second author would like to thank him for the good collaboration in Aachen as a colleague and as a neighbor.

Abstract

The numerical solution of a symmetric hypersonic blunt body flow in two space dimensions is considered, and the problem of the arising chemical boundary layer is discussed. Analytical and numerical investigations are used to analyze the solution on the stagnation point streamline. We point out the necessary assumptions to obtain an equivalent system of ordinary differential equations along this line and to get a unique solution. We also describe the situation in the limiting case at the stagnation point and give a differential algebraic system from which we obtain the solution at this point. We derive the shape of the boundary layer by linearizing the equations and some of the results are different to previous ones. Then we present numerical tools to get a better indication of this boundary layer even in 2D calculations.

1 Introduction

In the case of a hypersonic, inviscid continuum flow past a blunt body, a so-called bow shock (shown in Figure 1) is formed. The flow is composed of a subsonic and a hypersonic part (between the shock and the wall), separated by the sonic line. Details can be found in [1], [2].

Here we are particularly interested in

- the stand-off distance and
- the stagnation point.