**Prandtl Meyer Expansion**

*Simulation Course*

*Escola Tècnica Superior d'Enginyeria de Telecomunicacions i Aeroespacial de Castelldefels*

*Universitat Politecnica de Catalunya*

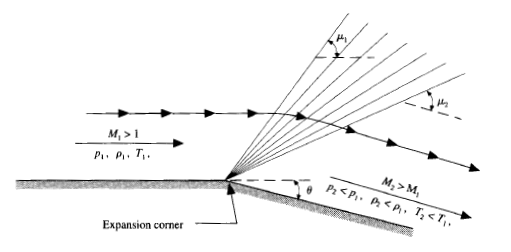
León Enrique Prieto Bailo [leon.enrique.prieto@estudiantat.upc.edu](mailto:leon.enrique.prieto@estudiantat.upc.edu) Verónica Sastre Rojo [veronica.sastre@estudiantat.upc.edu](mailto:veronica.sastre@estudiantat.upc.edu)

**Description of the problem**

The Prandtl-Meyer expansion is the process that occurs when a supersonic flow turns around a convex corner, forming a divergent fan consisting of an infinite number of Mach waves. A two-dimensional, inviscid and supersonic flow will be analyzed in this project.

Across the expansion fan, the flow accelerates so, the [Mach number](https://en.wikipedia.org/wiki/Mach_number) increases and the [static pressure](https://en.wikipedia.org/wiki/Static_pressure), [temperature](https://en.wikipedia.org/wiki/Temperature) and [density](https://en.wikipedia.org/wiki/Density) decrease.

Since the flow turns in small angles and the changes across each expansion wave are small, the whole process is isentropic. Due to the fact that the whole process is isentropic, the stagnation pressure, temperature and density remain constant across the fan. This fact simplifies the calculations of the flow properties significantly.



*Figure 1. Prandtl Meyer expansion wave*

Due to the fact that the inviscid flow must easily notice the shape of the surface over which it is flowing, it is vital to couple the surface boundary condition into the flow-field calculation. For this reason, a numerical mathematics adjustment will be done.

The space marching technique that will be applied for the solution of the two-dimensional supersonic flow problem is MacCormack's. It is a second order discretization scheme for the numerical solution of hyperbolic partial differential equations.

**Relevance**

**Why this simulation is important?**