

Free Boundary Problem with Mixed type PDE: Transonic shocks

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Goal of lecture: In this series of lecture, the following subjects will be covered through a simple example.

- (i) What is a shock?
- (ii) How to formulate a mathematical problem from physical observation?
- (iii) How to solve a shock problem?

Lecture 1. Introduction

- Euler system for compressible flow
- Derivation of Rankine-Hugoniot conditions
- One dimensional transonic shock solution

Lecture 2. Multi-dimensional transonic shock problem Part I

- Normal shock in a rectangular domain
- Potential flow
- Hyperbolic-elliptic mixed type nonlinear PDE
- Derivation of a free boundary problem

Lecture 3. Multi-dimensional transonic shock problem Part II

- Supersonic solution (Quick review on hyperbolic PDE)

Lecture 4. Multi-dimensional transonic shock problem Part III

- Subsonic solution (Quick review on Elliptic PDE)

Lecture 5. Multi-dimensional transonic shock problem Part IV

- How to solve a transonic shock problem?
- Open problems for you