

## MA4198 PROJECT PROPOSAL (PROJECT CUM SEMINAR GROUP)

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### SUPERVISOR'S INFO

<b>Name:</b>	Cai Zhenning
<b>Email:</b>	matcz@nus.edu.sg
<b>Tel number:</b>	65166250
<b>Office location:</b>	S17-04-06

### PROJECT ID: PS02

### TITLE

Asymptotic Methods for Linear Hyperbolic Equations

### BRIEF DESCRIPTION OF PROJECT

We study the model reduction of large linear hyperbolic equations with a zeroth-order term. Such a problem may arise from many mechanical fields such as the rarefied gas dynamics and radiative transfer. When the zeroth-order term is large, we may use only a few variables to represent the behavior of the entire system, leading to a much lower computational cost. Two methods for the model reduction will be studied in this project. The first is a classical method known as the Chapman-Enskog expansion, which may lead to unstable equations when we truncate the series to a high order. The second method, known as the method of asymptotic projection, is developed only recently and can always lead to stable equations. But the resulting system may contain more equations than the Chapman-Enskog expansion.

### EXPECTATION/S

1. Reproduce the results of Chapman-Enskog expansion for simple linear systems.
2. Apply the method of asymptotic projection to some simple linear systems.
3. Test the performance of both methods.

### PREREQUISITE/S (at level 3000 or below, with at most one course at level 3000)

MA2001, MA3220

### READING REFERENCE/S

Janusz Mika, Hilbert and Chapman-Enskog asymptotic expansion methods for linear evolution equations, Progress in Nuclear Energy, Volume 8, Issues 2–3, 1981, Pages 83-94.