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| Weekly Research Report | | | |
| Name | Aiyung | Duration | 2024/10/30 ~ 2024/11/06 |
| Date | 2024/11/06 | (week 8) | |

* Bring your research notebook every time for cross check when present your weekly report.
* The weekly report should be written over 1 page.

1. Brief title of this report (本報告主題)

無網格法的數學推導。

1. Research issue address at … (研究過程中發現的問題)

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1. Method or possible solutions (提出可能的解決方法)

## Problem statement (strong form):

where:

## Derive the [weak form:](https://en.wikipedia.org/wiki/Weak_formulation)

Given find   
such that , where

1. Multiply the governing equation by a trial function
2. Integration by part
3. Divergence theorem
4. Substitute the boundary: (1) , (2)
5. Constitutive relationship of material

where

## Derive [Galerkin form](https://en.wikipedia.org/wiki/Galerkin_method)

Given find   
such that .

We approximate the displacement field and trial function by: points and shape function :

where

## Derive Matrix form

To write the problem in terms of matrices, we have (1) the stiffness matrix , displacement vector , and force vector .

Where

Now we have the matrix form in following:

Or

# Each matrix in 3D

## Stress tensor,

## Strain tensor,

## Elasticity tensor,

For isotropic material, would be looked like:

## Shape function,

## Strain-Displacement Matrix,

# The Mesh-free modification (Reproducing Kernel Particle Method)

Continuing from Galerkin form, instead of approximate displacement by:

Consider following RK function:

Where:

The shape function can be expressed as:

Where:

The correction function is:

Where

can be expressed as follows:

Apply reproducing condition:

We get

Where

The final step:

# Note:

## Sobolev Space (索伯列夫空間)

space: n-th derivatives exist, and it and its derivatives are square-integrable.

### In 3D elastic problem:

For the displacement field and trial function .

The function space consists of vector-valued functions where each component belongs to , defined as:

Where:

is the space of **square-integrable** functions, i.e., if:

1. Outcomes and new derivative problems (因應該方法產生的結果，及或衍生的新問題)

不太確定是否需要寫那麼詳細。或是需要更多背景知識（如tensor calculation）

1. Conclusion & Discussions (小結與討論)

已充分透過MATLAB實作無網格法，開始進行軟體規劃。

1. Plan for next week (下周預期工作內容，提出可能解決本周問題的幾種規劃)

進行初步openGL視窗開發，實作讀取.ply, .obj功能。