

利用零場邊界積分方程法分析處置坑道受水平剪力波之動態行為

Study on the dynamic behavior of deposition tunnels by SH-wave using the null-field boundary integral equation method

Jing-Wen Yu (余靜玟) and Shi-En Hong (洪仕恩), *Department of Civil Engineering, Tamkang University, Taiwan*
(hhappy871007@gmail.com)

Advisor: Prof. Jia-Wei Lee (李家瑋) and Prof. Zon-Yee Yang (楊長義)

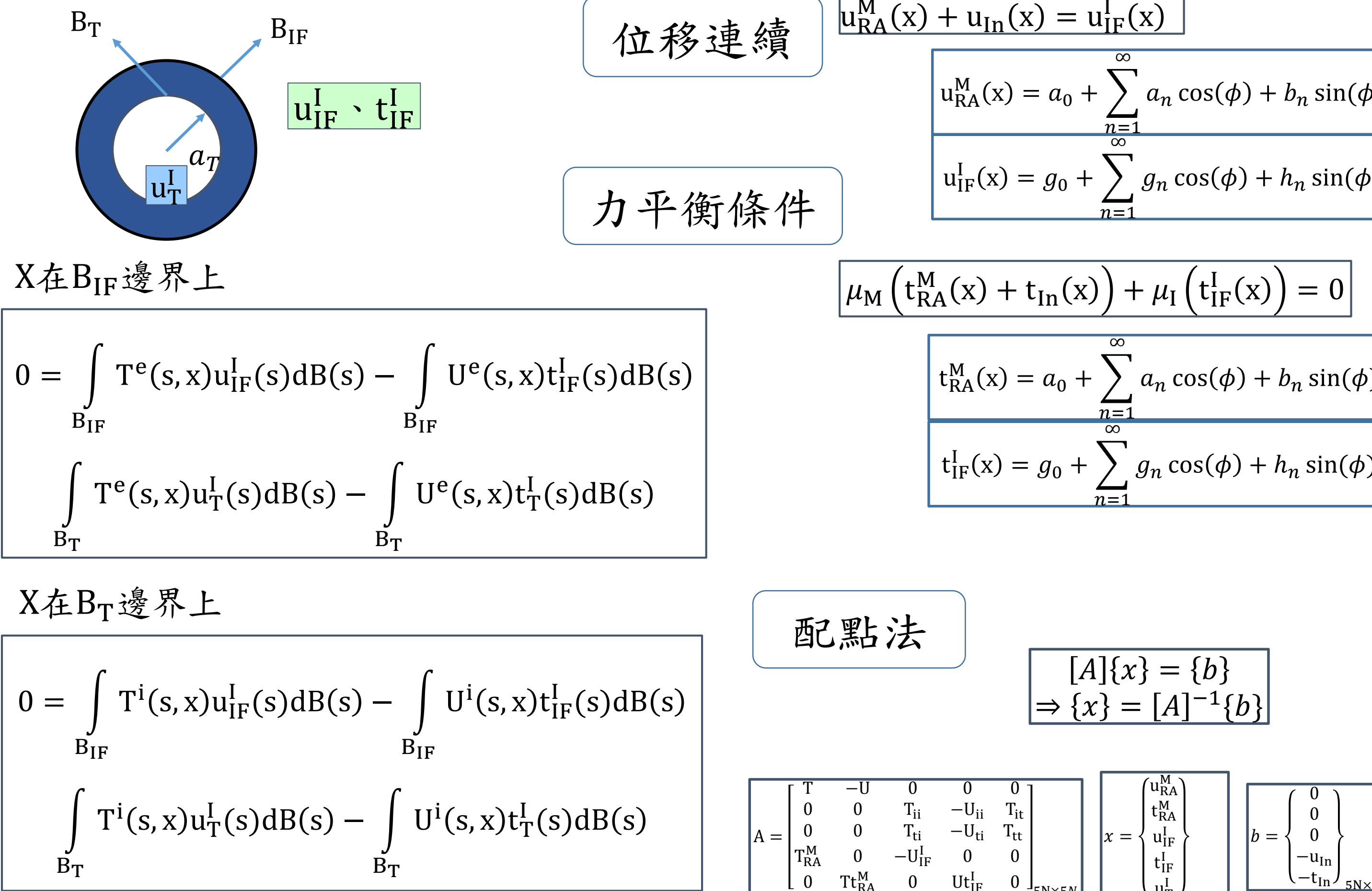
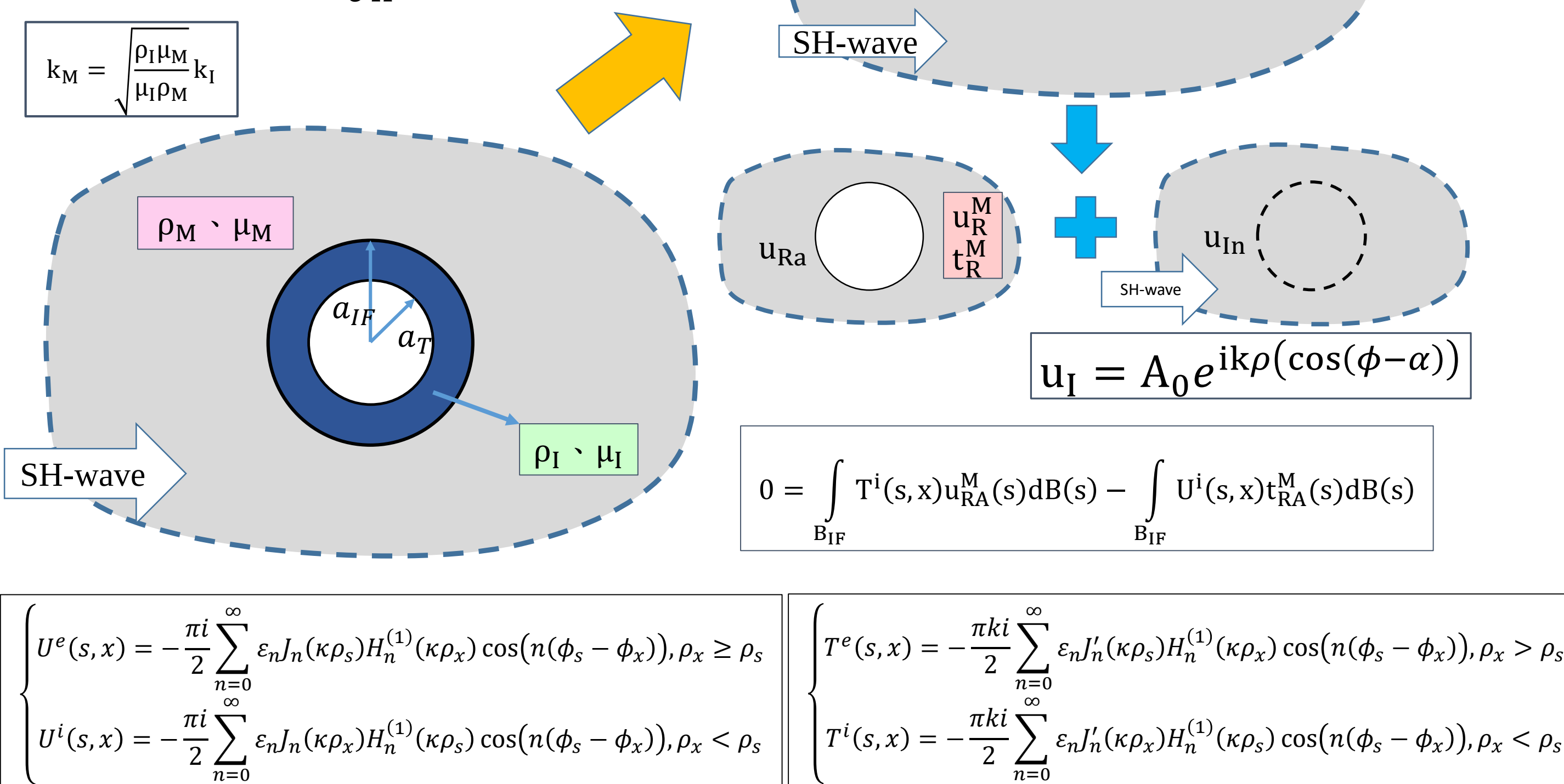
Abstract

用過核子燃料的最終地質處置坑道之開挖施工過程，常造成坑道壁附近母岩的損傷，導致圍岩之岩石彈性性質(例如剪力模數)產生不同程度的劣化，長期影響其天然障壁的阻絕與遲滯功能，以及處置坑道的力學穩定性，故開挖損傷議題一直是近二十年來國際處置先進國家的重要研究課題。本研究將採用零場邊界積分方程法之分析技巧，配合夾雜問題概念，可來描述開挖損傷材料性質的不連續特性，以探討地底處置坑道在受地震水平剪力波傳遞作用時，在處置岩體及坑道所產生的動態位移分佈特徵、以及在坑壁之動態應力集中問題，藉以瞭解坑道開挖損傷程度之關鍵影響性，並藉以可瞭解坑道群之配置距離的受震遮蔽效應。研究目的期望開發一套具有可考慮岩石開挖損傷之零場邊界積分方程法分析程式，提供我國分析處置坑道岩盤受地震波傳遞作用之動態力學行為，並可作為一平行驗證數值模擬技術，可進而提升我國地質處置坑道設計之觀念。

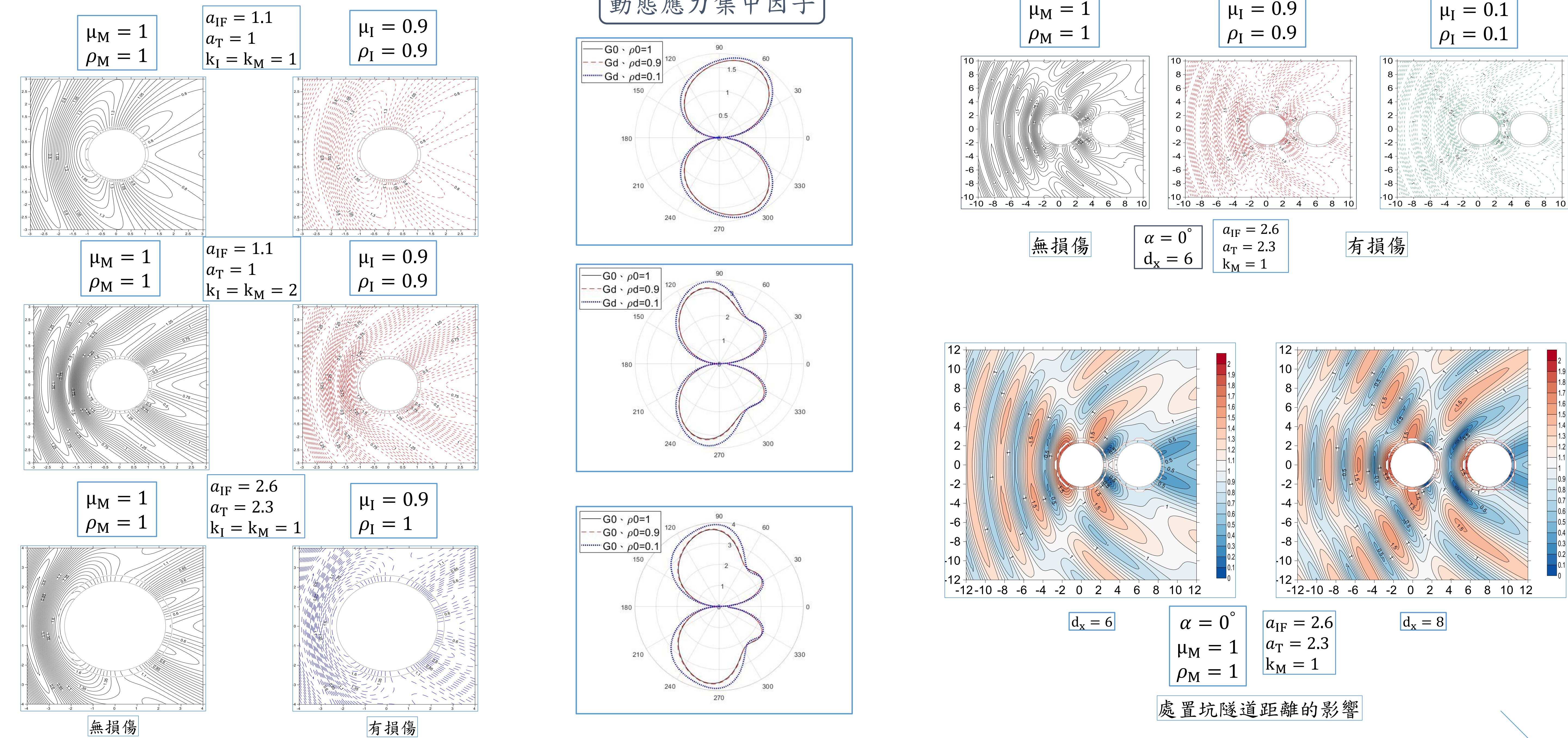
Problem description

控制方程式 $\Rightarrow \nabla^2 u + k^2 u = 0$

邊界條件 $\Rightarrow \mu_I \frac{\partial u}{\partial n} = 0$



Results and discussion



Conclusions

- 假設地震波從左邊入射進來以及透過觀察全場位移振福，我們發現
- (1) $\phi_x = \pi$ 最直接受到地震波影響，但全場位移振幅最大值卻在該點兩側。
- (2) 隧道受損層越厚，其影響越顯著。
- (3) μ_I, ρ_I 越小，位移振幅有明顯的變化。
- (4) 只有 μ_I 受到改變，其位移振幅有劇烈的變化。

References

- [1]Chen J.T, Chen P.Y. and Chen C.T. “Surface motion of multiple alluvial valleys for incident plane SH-waves by using a semi-analytical approach” Soil Dynamics and Earthquake Engineering, 28, 58-72, (2008).
- [2]Hei B.P, Yang Z.L. and Chen Z.G. “Scattering of shear waves by an elliptical cavity in a radially inhomogeneous isotropic medium” Earthquake Engineering and Engineering Vibration 15, 145-151, (2016).
- [3]Chen J. T., Kao S.K., Hsu Y.H. and Fan Y “Scattering problems of the SH wave by using the null-field boundary integral equation method” Journal of Earthquake Engineering, 22, 1363-2469, (2017).
- [4]Shih, Y.T., SH-wave scattering by circular hole in a functionally graded material using the null-field boundary integral equation method, Thesis supervised by Prof. Jia-Wei Lee, Department of Civil Engineering, Tamkang University, New Taipei City, Taiwan (2019).
- [5]Hong,S.E, SH-wave scattering problems containing circular holes in a functionally graded material and bimaterial using the null-field boundary integral equation method.Thesis supervised by Prof. Jia-Wei Lee, Department of Civil Engineering, Tamkang University, New Taipei City, Taiwan (2020).