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On the Longitudinal and Flexural Waves Interaction with Thin Adhesive Joint Connections

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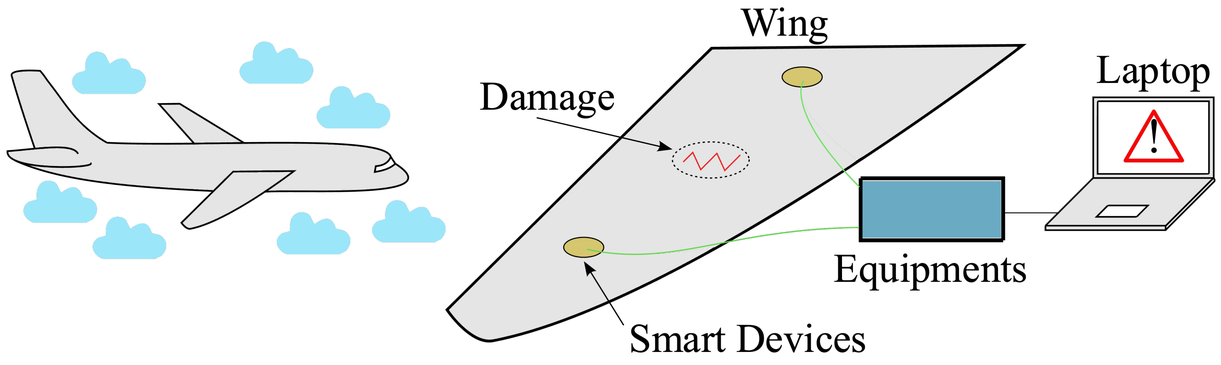
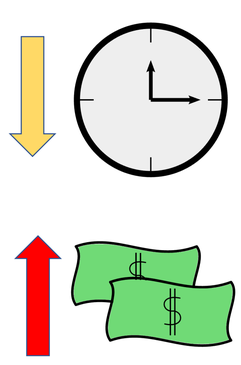
Introduction: Structural Health Monitoring and Joint Connections





Use of joints in different applications

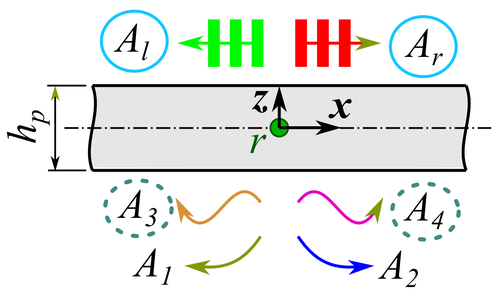
Examples:

(a) Butt joint

(b) Lap joint

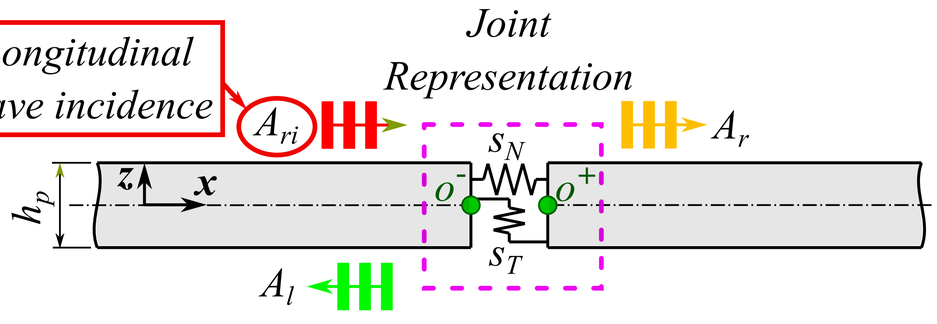
Methods

Longitudinal and Flexural Wave Propagation in Plates



Longitudinal wave incidence

Joint Representation

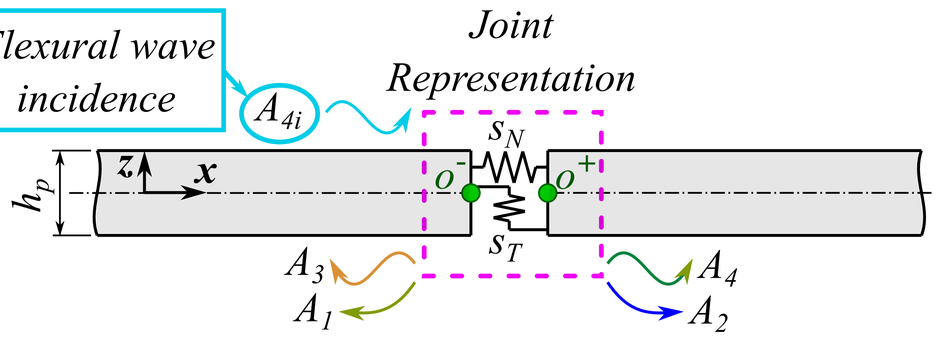


Reflected wave	*Transmitted wave*
$R_l = \frac{A_l}{A_{ri}} = \frac{i}{(2\beta + i)}$	$T_l = \frac{A_r}{A_{ri}} = \frac{2\beta^2}{(\beta + i)(2\beta + i)}$

$$\beta = \frac{s_N(1-\nu_p^2)}{k_l E_p h_p}$$

Flexural wave incidence

Joint Representation



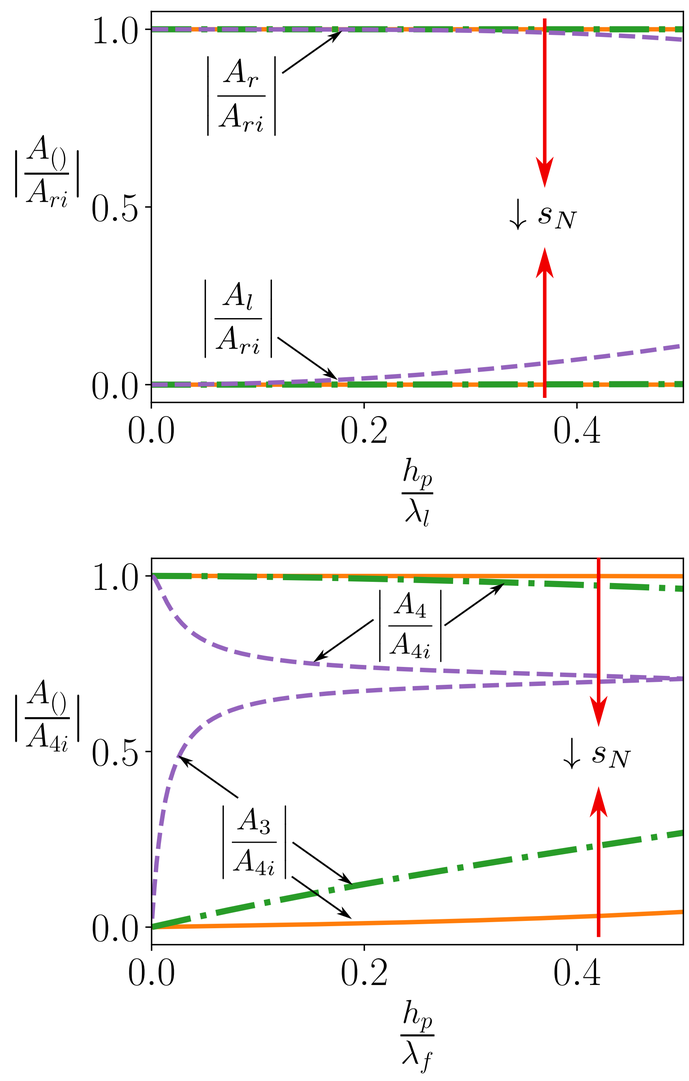
Reflected wave
$R_f = \frac{A_3}{A_{4i}} = -\frac{i\,(2\theta + 2\gamma + 1)}{8\theta\gamma + 2\theta\,(1-i) + 2\gamma\,(1+i) + 1}$

Transmitted wave
$T_f = \frac{A_4}{A_{4i}} = \frac{2\,(4\theta\gamma + \theta + \gamma)}{8\theta\gamma + 2\theta\,(1-i) + 2\gamma\,(1+i) + 1}$

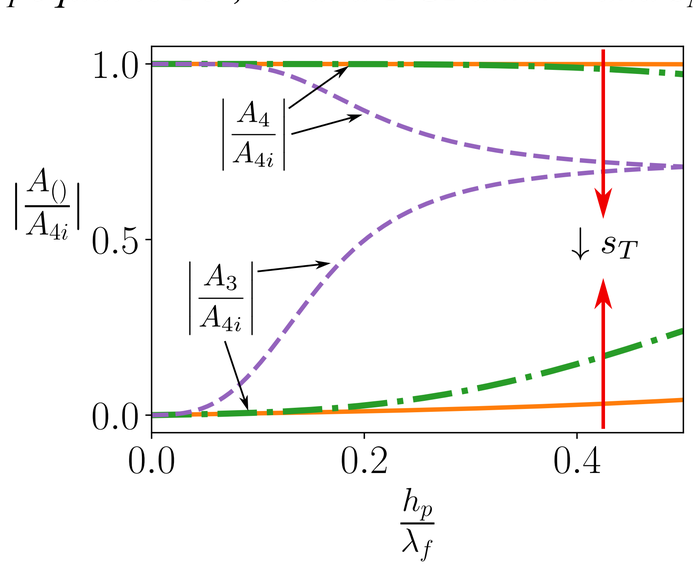
$$\theta = \frac{s_N h_p^3}{12 D_p k_f} \qquad \gamma = \frac{s_T h_p}{D_p k_f^3}$$

Discussion/Results

- For s_N equal to 10^3, 70 and 1 GPa.mm^{-1} and $s_T = 10^3$ GPa.mm^{-1}



- For s_T equal to 10^3, 70 and 1 GPa.mm^{-1} and $s_N = 10^3$ GPa.mm^{-1}



Conclusions

Longitudinal and flexural waves can be used to monitor thin adhesive joint connections. The longitudinal wave only depends on the stiffness s_N. The flexural wave is more sensitive to changes in the s_N and can be also used to evaluate s_T. The results contribute to monitoring thin adhesive joint connections based on wave propagation.

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