Free vibration analysis of cracked rotating multi-span Timoshenko beams using differential transform method

Mohammad Raeisi, Alireza Ariaei*

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orealtext
با توجه به شرایط سازگاری در میدان جابجایی، جابجایی خارجی، شش مان خصوصی، توربی پرتو و توربی محرر شرایط پیوستی در هر سکتیکی (شکل ۳) بصورت (۱۴) است:

\[ w_{t+1}(x_t^+, t) = -w_t(x_t^+, t) \cos(\theta_t) + u_t(x_t^+, t) \sin(\theta_t) \] \[ u_{t+1}(x_t^+, t) = u_t(x_t^+, t) \cos(\theta_t) - w_t(x_t^+, t) \sin(\theta_t) \] \[ E\theta_{t+1}(x_t^+, t) = -kGAw_{t+1}(x_{t+1}^+, t) - \varphi_t(x_t^+, t) \cos(\theta_t) \] \[ E\varphi_{t+1}(x_t^+, t) = -kGAw_t(x_{t+1}^+, t) - \varphi_t(x_t^+, t) \sin(\theta_t) \] \[ E\lambda_{t+1}(x_t^+, t) = -kGAw_{t+1}(x_{t+1}^+, t) - \varphi_t(x_t^+, t) \sin(\theta_t) \]

که در آنها \( x_t^+ \) و \( x_t^- \) مانند شکل ۳ زیر و بعد از شکلی‌سازی به عنوان ترکیباتی قابل به کار بردن در تقریب ۳ به صورت (۳۲) جو از (۱۲) و (۱۳)

\[ T_{c}(x) = \int_{x_{-1}}^{x_{n+1}} \rho \Delta \Omega \int \left[ R + \rho \cos(\theta_t) \sum_{k=1}^{m} L_k \cos(\alpha_k) \right] dx \]

\[ + \sum_{j=0}^{n} \int_{j}^{j+1} \rho \Delta \Omega \int \left[ R + \rho \cos(\theta_t) \sum_{k=1}^{m} L_k \cos(\alpha_k) \right] dx \]

\[ i = 1, 2, \ldots, n + m + 1 \] \[ \rho A \frac{\partial^2 \psi_t(x, t)}{\partial x^2} + \rho \Delta \Omega \int \left( \frac{\partial \psi_t(x, t)}{\partial x} \right) dx = \frac{R_{t}(x)}{\rho \Delta \Omega} \]

\[ \frac{i = 1, 2, \ldots, n + m + 1}{} \]

\[ \frac{l \rho \frac{\partial^2 \psi_t(x, t)}{\partial x^2} - \rho \Delta \Omega \int \psi_t(x, t) dx}{\partial x} = \frac{R_{t}(x)}{\rho \Delta \Omega} \]

\[ \frac{l = 1, 2, \ldots, n + m + 1}{} \]

\[ \rho A \frac{\partial^2 \psi_t(x, t)}{\partial x^2} + \rho \Delta \Omega \int \left( \frac{\partial \psi_t(x, t)}{\partial x} \right) dx = \frac{R_{t}(x)}{\rho \Delta \Omega} \]

\[ \frac{i = 1, 2, \ldots, n + m + 1}{} \]
\[ \zeta = \frac{X}{L} \] (39)

شسته \( \zeta \) و \( \xi \) پیان کندننده نقطه قبل و بعد از شکستگی هستند که تقاضای رابطه (39) تعیین می‌شود.

شیار پیوستگی \( \theta \) بعد شده در محل ترک صورت معادلات (40-45) خواهد بود:

\[ \phi_{i+1}(\xi, t) = \phi_{i}(\xi, t) \] (40)

\[ [w_{i+1}(\xi, t) - \phi_{i+1}(\xi, t)] = [w_{i}(\xi, t) - \phi_{i}(\xi, t)] \] (41)

\[ \frac{1}{k_{0}} \langle A \rangle [w_{i+1}(\xi, t) - \phi_{i+1}(\xi, t)] \] (42)

\[ \phi_{i+1}(\xi, t) - \phi_{i}(\xi, t) = \frac{1}{k_{0}} E [w_{i+1}(\xi, t) - \phi_{i+1}(\xi, t)] \] (43)

\[ u_{i+1}(\xi, t) = w_{i}(\xi, t) \] (44)

\[ u_{i+1}(\xi, t) = u_{i}(\xi, t) \] (45)

که در آن \( \xi \) و \( \psi \) پیان کندننده نقطه قبل و بعد از ترک \( \zeta \) هستند که

مثابه رابطه (46) تعیین می‌شود.

\[ \zeta_c = \frac{X}{L} \] (46)

3-2-2 - بی‌سازی پارامترهای

اینک برای بی‌سازی معادلات پارامترهای بعد شده از مثابه رابطه (25) تعیین می‌شود:

\[ \eta = \frac{\alpha A_{T, i}^{2}}{\alpha_{T, i}} \quad \rho = \frac{\rho A_{T, i}^{2}}{\alpha_{T, i}} \] (25)

\[ \lambda = L_{i} \] (26)

\[ \lambda = L_{i} \] (27)

\[ \frac{1}{R^{2}} U_{i} = \frac{1}{\mu} \frac{dW_{i}}{d\xi} = \frac{1}{\mu} \frac{dW_{i}}{d\xi} \] (28)

\[ \frac{1}{R^{2}} U_{i} = \frac{1}{\mu} \frac{dW_{i}}{d\xi} = \frac{1}{\mu} \frac{dW_{i}}{d\xi} \] (29)

\[ \theta_{i+1}(\xi, t) = \theta_{i}(\xi, t) \] (30)

\[ \frac{1}{R^{2}} U_{i} = \frac{1}{\mu} \frac{dW_{i}}{d\xi} = \frac{1}{\mu} \frac{dW_{i}}{d\xi} \] (31)

\[ \frac{1}{R^{2}} U_{i} = \frac{1}{\mu} \frac{dW_{i}}{d\xi} = \frac{1}{\mu} \frac{dW_{i}}{d\xi} \] (32)

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\[ \frac{1}{R^{2}} U_{i} = \frac{1}{\mu} \frac{dW_{i}}{d\xi} = \frac{1}{\mu} \frac{dW_{i}}{d\xi} \] (36)

\[ \frac{1}{R^{2}} U_{i} = \frac{1}{\mu} \frac{dW_{i}}{d\xi} = \frac{1}{\mu} \frac{dW_{i}}{d\xi} \] (37)

\[ \frac{1}{R^{2}} U_{i} = \frac{1}{\mu} \frac{dW_{i}}{d\xi} = \frac{1}{\mu} \frac{dW_{i}}{d\xi} \] (38)

\[ \frac{1}{R^{2}} U_{i} = \frac{1}{\mu} \frac{dW_{i}}{d\xi} = \frac{1}{\mu} \frac{dW_{i}}{d\xi} \] (39)

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\[ \frac{1}{R^{2}} U_{i} = \frac{1}{\mu} \frac{dW_{i}}{d\xi} = \frac{1}{\mu} \frac{dW_{i}}{d\xi} \] (46)

\[ \frac{1}{R^{2}} U_{i} = \frac{1}{\mu} \frac{dW_{i}}{d\xi} = \frac{1}{\mu} \frac{dW_{i}}{d\xi} \] (47)

\[ \frac{1}{R^{2}} U_{i} = \frac{1}{\mu} \frac{dW_{i}}{d\xi} = \frac{1}{\mu} \frac{dW_{i}}{d\xi} \] (48)

\[ \frac{1}{R^{2}} U_{i} = \frac{1}{\mu} \frac{dW_{i}}{d\xi} = \frac{1}{\mu} \frac{dW_{i}}{d\xi} \] (49)

\[ \frac{1}{R^{2}} U_{i} = \frac{1}{\mu} \frac{dW_{i}}{d\xi} = \frac{1}{\mu} \frac{dW_{i}}{d\xi} \] (50)

\[ \xi = \frac{2l}{l} \frac{y}{y} + 37.14 y^2 + 35.84 y^3 + 13.12 y^4 \] (24)

شکل 3: (اندازه‌گیری‌بندی به صورت) مدل ترک
\[
\begin{align*}
\sum_{k=0}^{\infty} (\zeta_1)^k U_{i+1}[k] &= -\sum_{k=0}^{\infty} (\zeta_1)^k U_i[k] \sin(\theta_i) - \sum_{k=0}^{\infty} (\zeta_1)^k U_i[k] \cos(\theta_i) \\
\sum_{i=1} (\zeta_1)^{-1} k (W_{i+1}|k] - W_i[k]) &= 0 \\
\sum_{i=1} (\zeta_1)^{-1} k (\phi_{i+1}[k] - \phi_i[k]) &= 0 \\
\sum_{i=1} (\zeta_1)^{-1} k W_{i+1}[k] = & -\sum_{i=1} (\zeta_1)^{-1} k W_i[k] - \sum_{k=0}^{\infty} (\zeta_1)^k \phi_{i+1}[k] \sin(\theta_i) \\
& + \sum_{k=0}^{\infty} (\zeta_1)^k \phi_{i+1}[k] \cos(\theta_i) \\
\sum_{i=1} (\zeta_1)^{-1} k U_{i+1}[k] = & -\sum_{i=1} (\zeta_1)^{-1} k U_i[k] - \sum_{k=0}^{\infty} (\zeta_1)^k \phi_{i+1}[k] \sin(\theta_i) \\
& + \sum_{k=0}^{\infty} (\zeta_1)^k \phi_{i+1}[k] \cos(\theta_i)
\end{align*}
\]

جدول 2: تابع انتقال معادلات دیفرانسیل

<table>
<thead>
<tr>
<th>شرط مرزی اصلی</th>
<th>شرط مرزی انتقال</th>
<th>تابع انتقال</th>
</tr>
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<tbody>
<tr>
<td>( f(0) = 0 )</td>
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<td>( F(k) = \delta(k-0) )</td>
</tr>
<tr>
<td>( df )</td>
<td>( df )</td>
<td>( \mu + \nu - \frac{1}{\mu^2} \theta(k) )</td>
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<tr>
<td>( df )</td>
<td>( df )</td>
<td>( \mu + \nu - \frac{1}{\mu^2} \theta(k) )</td>
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<td>( \mu + \nu - \frac{1}{\mu^2} \theta(k) )</td>
</tr>
<tr>
<td>( df )</td>
<td>( df )</td>
<td>( \mu + \nu - \frac{1}{\mu^2} \theta(k) )</td>
</tr>
</tbody>
</table>

\[
\frac{1}{t}\left(1 + \frac{k}{k+1}\right)^2 + \left(\mu^2 + \frac{1}{\mu^2}\right) \theta(k) + \sum_{i=1}^n \left(\mu + \nu - \frac{1}{\mu^2}\right) \theta(k) + \sum_{i=1}^n \left(\mu + \nu - \frac{1}{\mu^2}\right) \theta(k)
\]

\[
\frac{1}{t^2}\left(1 + \frac{k}{k+1}\right)^2 + \left(\mu^2 + \frac{1}{\mu^2}\right) \theta(k) + \sum_{i=1}^n \left(\mu + \nu - \frac{1}{\mu^2}\right) \theta(k) + \sum_{i=1}^n \left(\mu + \nu - \frac{1}{\mu^2}\right) \theta(k)
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\[
\frac{1}{t^2}\left(1 + \frac{k}{k+1}\right)^2 + \left(\mu^2 + \frac{1}{\mu^2}\right) \theta(k) + \sum_{i=1}^n \left(\mu + \nu - \frac{1}{\mu^2}\right) \theta(k) + \sum_{i=1}^n \left(\mu + \nu - \frac{1}{\mu^2}\right) \theta(k)
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\frac{1}{t^2}\left(1 + \frac{k}{k+1}\right)^2 + \left(\mu^2 + \frac{1}{\mu^2}\right) \theta(k) + \sum_{i=1}^n \left(\mu + \nu - \frac{1}{\mu^2}\right) \theta(k) + \sum_{i=1}^n \left(\mu + \nu - \frac{1}{\mu^2}\right) \theta(k)
\]

\[
\frac{1}{t^2}\left(1 + \frac{k}{k+1}\right)^2 + \left(\mu^2 + \frac{1}{\mu^2}\right) \theta(k) + \sum_{i=1}^n \left(\mu + \nu - \frac{1}{\mu^2}\right) \theta(k) + \sum_{i=1}^n \left(\mu + \nu - \frac{1}{\mu^2}\right) \theta(k)
\]
3 - نتایج معمولی
در این فصل سه داده‌ای که در دو روش شناختی و میکروسکوپی به دست آمده و در کمک‌رسانی در ترکب‌های نانو و پارامترهای آماری قرار می‌گیرد.

3.1 - ترکب‌های نانویی

در این بخش سه داده‌ای که در دو روش شناختی و میکروسکوپی به دست آمده و در کمک‌رسانی در ترکب‌های نانو و پارامترهای آماری قرار می‌گیرد.

شکل ۵: شکل مورد اول به دست آمده از روش شناختی دفرنسلس و آکوس

شکل ۶: شکل مورد اول به دست آمده از روش انتقال دفرنسلس و آکوس

شکل ۷: شکل مورد اول به دست آمده از روش انتقال دفرنسلس و آکوس

\[
\begin{align*}
\phi_i | \phi & = C_{ii} \\

V_i | \phi & = C_{i\phi}
\end{align*}
\]

با جایگذاری این روابط در معادلات (۵۴-۵۶) برای مقادیر مختلف \( \phi \)

\[
\begin{align*}
\text{مقدار مختلف} & = 6 \text{ مقدار مختلف} \\
\text{مقدار مختلف} & = 6 \text{ مقدار مختلف}
\end{align*}
\]

\[
\begin{align*}
\text{مقدار مختلف} & = 6 \text{ مقدار مختلف} \\
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\end{align*}
\]
فکراکس طیبیه ببد دوم برای سرعت‌های دورانی ببد و زاویه‌های متفاوت

فکراکس طیبیه ببد سوم برای سرعت‌های دورانی ببد و زاویه‌های متفاوت

فکراکس طیبیه ببد چهارم برای سرعت‌های دورانی ببد و زاویه‌های متفاوت

فکراکس طیبیه ببد اول برای سرعت‌های دورانی ببد و زاویه‌های متفاوت
جدول 3-3 محاسبه مولفه‌های مختلف برای این فرکانس‌ها

<table>
<thead>
<tr>
<th>فرکانس (میگاهرتز)</th>
<th>پنجم</th>
<th>چهارم</th>
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<th>دوم</th>
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در جدول 4 صفر مقیاسی اول برابر این پنجم و مولفه‌های مختلف برای این پنجم یک درجه از این فرکانس‌ها داده شده است. برای این پنجم یک درجه از این فرکانس‌ها، به صورت معمولی، شاخص دیده شده است. برای این پنجم یک درجه از این فرکانس‌ها، به صورت عکسی، شاخص دیده شده است. برای این پنجم یک درجه از این فرکانس‌ها، به صورت به‌صورتی، شاخص دیده شده است. برای این پنجم یک درجه از این فرکانس‌ها، به صورت جایگزین، شاخص دیده شده است. برای این پنجم یک درجه از این فرکانس‌ها، به صورت جایگزین، شاخص دیده شده است.
جدول ۴ برخی از نتایج که در مقاله‌ی انگلیسی ذکر شده‌اند:

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![شکل ۴۴](https://mme.modares.ac.ir/wp-content/uploads/2021/08/44.png)

شکل ۴۴ که نشان دهنده خطا در اندازه‌گیری زاویه بین پنجره و پنجره‌ای که در زاویه خاصی واقع شده است.

شکل ۱۵ مکان‌های مختلف ترک
تکیه‌گاه گیرنده، فرکانس آرفادش می‌باشد و به فرکانس آرفادش بیان نیز ترک نرخ
زدنی می‌باشد. در سایر فرکانس‌های طبیعی نزدیک به آن و با شنیدن ترک از
گروهی از دو روشی مربوط به تنبیه افتادگی و با کاهش آن، بیان
اختلاف نمایشگر در این جدول بین تابیها، حاوی و با تغییرات
کمتر از 0.05 درصد است.

۴- نتیجه‌گیری

در مقاله‌ای از تحلیل حرارتی ترک نزدیک نیز، ترک دو گروه را بررسی قرار گرفت
این برای حل مسائلی از این بین، حل تابیال‌دانس استفاده و فرکانس،
ها و شکل موادی است که این ترک برای شکستگی، سرعت دوران
و موقعیت ترک روز فرکانس‌های طبیعی مورد بررسی قرار گرفت و میثاقی
شد که تغییر زیان نکستگی از متقابلی و فرکانس‌های متفاوت نشی می‌باشد.
گونه‌ی که می‌باشد به فرکانس‌های فشرده‌ی برخی دیگر
ربو به افتادگی سرعت می‌باشد فرکانس طبیعی فرکانس آرفادش،
آرفادش می‌باشد و قدر
این تحلیل برای افتادگی فرکانس‌های طبیعی فرکانس آرفادش و
سیستم‌های برخی دیگر. فرکانس‌های آرفادش، به نظر و حاصل
مانند این در نمونه‌ی افتادگی که این تحلیل در بسیاری از
طلایه بیان نشان داده‌های روش این آرفادش در تحلیل
از تحلیل آرفادش است.

۵- فهرست عناوین

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۶- مراجع