Mechanical and Structural Vibration: Theory and Applications

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Pg. 15, second line: ...and \( L_2 + x_2 - x_1 \), respectively, ...
Pg. 15, 2nd eq. and eq. (1.4.6): darken overdots above \( \Delta \) for damping terms.
Pg. 16, eq. (1.4.8): insert overdots in damping term:

\[
\cdots \left[ \begin{array}{cc}
(c_1 + c_2) & -c_2 \\
-c_2 & c_2 \\
\end{array} \right] \left\{ \begin{array}{c}
\dot{x}_1 \\
\dot{x}_2 \\
\end{array} \right\} + \cdots
\]

Pg. 41, 6th line following figure: \( \Delta_3 = \cdots = y \cdots \)
Pg. 41, 2nd equation: \( V_{sp} = \cdots + \frac{1}{2} k_3 (y)^2 \)
Pg. 41, 3rd equation from bottom: \( V = \frac{1}{2} (K_{11} x^2 + \cdots \)
Pg. 45, 3 lines from bottom: ... express \( P_{dis} \) in terms ...
Pg. 51, 2nd and 3rd equations: delete all overdots in expressions for \( \Delta r_D \) and \( \Delta r_E \)
Pg. 51, 3rd equation from bottom: Result should be \( P_{in} = 0.866 LF_1 \dot{\theta} \)
Pg. 52, 2nd figure: the downward force on the small gear is \( k \Delta_2 + \mu \dot{\Delta}_2 \)
Pg. 54, equation at top of page: insert overdots in damping term:

\[
\cdots [C] \left\{ \begin{array}{c}
\dot{\psi} \\
\dot{\theta} \\
\end{array} \right\} + \cdots
\]

Pg. 61, Exercise 1.47, third line: ...spring stiffness \( k_1 \text{and } \ldots \)
Pg. 61, Figure for Exercise 1.47: distance from pivot to force point is \( 2L/3 \).
Pg. 67, eq. (2.1.45), 2nd equation: change + to −, i.e.

\[
\cdots \sin(\omega t) = \frac{1}{2i} [\exp(i \omega t) - \exp(-i \omega t)]
\]

Pg. 67, eq. (2.1.6), 2nd equation: insert parentheses around \( i \omega t \) in both exponentials
Pg. 69, 3rd equation: \( A = \cdots = 4.605 + 1.947i \)
Pg. 69, 11 lines from bottom: ...we write \( abs(z) \), while ...
Pg. 70, eq. (2.1.3): Change sign preceding \( \phi_2 \) to a plus: \( \cdots + A_2 \cos(\omega t + \phi_2) \)
Pg. 70, eq. (2.1.4): Insert a minus sign before $i \phi_1$ in both lines, i.e. $\frac{A_1}{l} \exp (-i \phi_1)$

Pg. 98, 3rd equation: $n > \frac{x_0 - 4.905 \times 10^{-5}}{4 \Delta}$

Pg. 109, eq. (2.3.20): $g(t - \tau) = \lim_{T \to 0}$

Pg. 110, 4th line from bottom: ...the force, $|F|/k \equiv ...$

Pg. 111, Figure 2.19: the heading for the left graph should be $\zeta = 0.05$

Pg. 112, Exercise 2.5, Part (b), 2nd line from bottom: ... Write the complex amplitude in ...

Pg. 113, 2nd and 3rd lines of Exercise 2.14: Delete dots above $\Delta$

Pg. 116, Exercise 2.31, 2nd line following Item 3: ... frequency $\omega_{nat}$, the ratio ...

Pg. 117, figure for Exercise 2.35: delete subscript 1 from label for displacement arrow

Pg. 119, 4th line in Exercise 2.63: time $\omega_{nat} t$ over ...

Pg. 123, Figure 3.2, lower “0” label for vertical axis to the bottom left corner

Pg. 126, 5th line in Example 3.2, insert: $L = 2 \text{ m}$.

Pg. 129, last equation: $[\hat{F} \exp (i \Omega t) + \hat{F}^* \exp (-i \Omega t)]$

Pg. 134, 2nd line following figure: ...The two curves intersect the ...

Pg. 143, first graph: right label should be 200

Pg. 144, Figure 3.11: labels for spring and dashpot should be capitalized

Pg. 145, eq. (3.4.2): $-\vec{F} \cdot \vec{j} - Kq - C \ddot{q} = M \ddot{q}$

Pg. 151, 7th equation: $V = \ldots = \frac{1}{2} k \theta^2 \quad \Rightarrow$

Pg. 151, 2nd line after equation for $V$: $2a \dot{\theta}$, which (i.e. insert overdot)

Pg. 156, 2nd equation: $\ldots \hat{F}^*_n \exp (-i \omega_1 t)$

Pg. 160, 4th line from bottom of page: and $G_{(-N/2+1)}$ to $G_{N/2}$ are ...

Pg. 161, eq. (3.7.25), 1st line: $k = -\frac{N}{2} + 1, -\frac{N}{2} + 2, ..., \frac{N}{2}$

Pg. 178, 3rd paragraph, 2nd line: ... is well below the accelerometer’s natural ...

Pg. 178, eq. (3.7.57), 2nd line:

$$U_n = \frac{K + in \omega_1 C}{K + in \omega_1 C - n^2 \omega_1^2 M} Z_n \equiv \frac{1 + 2in \omega_1 \zeta}{1 + 2in \omega_1 \zeta - n^2 \omega_1^2} Z_n$$

Pg. 180, 2nd set of figures, heading for the left graph should be $\omega_{nat} T = 40 \pi$
Pg. 183, eq. (3.8.9) and 4 lines before: subscript in $\tau_d$ should be roman type.
Pg. 202, last line: Figure 3.26, as ...
Pg. 214, Exercise 3.42:

$$z(x) = \begin{cases} 
  h(1 - x^2/w^2) & \text{if } |x| \leq w \\
  0 & \text{if } w \leq |x| < L/2 \\
  z(x \pm L) & \text{if } |x| > L/2 
\end{cases}$$

Pg. 215, 2 lines before Exercise 3.45: ...90% of the highest critical
Pg. 224, eq. (4.2.4): $|\begin{bmatrix} K \\ \omega^2 \end{bmatrix} - |M|| = 0$
Pg. 225, eq. (4.2.7): lower left element of rectangular matrix should be

$$\left(K_{(N-1)1} - \omega_j^2 M_{(N-1)1}\right)$$

Pg. 226, eq. (4.2.8), 1st line: last element of column matrix is $\phi_{Nj}$
Pg. 230, 5th line after figure: ...Because $\theta$ is the pitch ...
Pg. 235, 2nd equation: lower left element of matrix should be $-1.8 \times 10^{-5}$
Pg. 239, 2nd equation: $... + 3Nx_N = 0$
Pg. 240, 1st line: $j = 1 : N; \text{phi}_n = \text{phi}_n/\sqrt{mu(j,j)}; \text{end.}$
Pg. 248, eq. (4.2.49), 2nd line...+$\alpha_{22} \{\phi'_{j+1}\}^T [M] \{\phi'_{j+1}\} = 0$
Pg. 248, eq. (4.2.50), second line:

$$\alpha_{22} = - \frac{\{\phi'_{j+1}\}^T [M] \{\phi_{j+2}\}}{\{\phi'_{j+1}\}^T [M] \{\phi'_{j+1}\}}$$

Pg. 250, last equation:

$$\phi^{<k>} := \phi^{<k>} - \frac{\left(\phi^{<k-1>}^T * M * \phi^{<k>}\right)_{1,1}}{\left(\phi^{<k-1>}^T * M * \phi^{<k-1>}\right)_{1,1}} * \phi^{<k-1>}$$

Pg. 255, first equation: $\ddot{v}_{2m} = \dot{q}_1 \ddot{q}_1$, ...
Pg. 256, 5th line of equations: $-m (\cos \theta) \omega_n^2 + (k - m \omega_n^2) \phi_{2n} = ...
Pg. 267, 2nd text line: $\ldots |M| \text{ is } \kappa_G = L/\sqrt{8}$
Pg. 272, 6th line of Exercise 4.10: $\ldots = \dot{x}_2 = 0 \text{ at } t = 0$
Pg. 284, Exercise 4.5, 7th line: and (b) $m_1 = 5 \text{ kg, } m_2 = \ldots$ (Then delete the following sentence)
Pg. 286, Exercise 4.12, part (d) $|K| = \ldots \text{N/m, } \omega_2 = \ldots$
Pg. 286, Exercise 4.12, part (d), list line: Determine the normal mode $\{\Phi_2\}$. 

3
Pg. 286, Exercise 4.13, 2nd line of 4th item: described above is ...

Pg. 287, Exercise 4.20, equation: $w = ...$

Pg. 287, Exercise 4.21, last line: and normal modes of this system.

Pg. 291, Exercise 4.47, one line before end: $q_n = \text{Re} \left[ Y_n \exp (i20t) \right]$ and ...

Pg. 298, eq. (5.2.2): $[G(\omega)] = [[K] (1 + i\gamma) - \omega^2 [M]]^{-1}$

Pg. 309, equation: $V = \frac{1}{2}k_0y_0^2 + ...$

Pg. 314, 7 lines before eq. (5.4.9). Insert: , $Q_j (k\Delta) = \beta_j f(k\Delta),$ $k = 0,1,...,K-1$. Simultaneously, ...

Pg. 314, eq. (5.4.9), 2nd line: $m = 0,1,...,K/2$

Pg. 319, Exercise 5.12, 9th line: ...cases, $\gamma = 0.001$ and $\gamma = 0.01$. ...

Pg. 322, Exercise 5.23, part(b), last line: ...platform at a designated ...

Pg. 322, Exercise 5.23, part (c)7th line. Insert: ...part(b) corresponding to 20 Hz. Use...

Pg. 325, 2nd paragraph, 3rd line: ...work of the Swiss mathematician....

Pg. 328, eq. (6.1.7), change superscript:

$$P_{\text{dis}} = \int_0^L \gamma E A \left( \frac{\partial \dot{u}}{\partial x} \right)^2 dx + \sum c \dot{u} (x, t)^2$$

Pg. 339, eq. (6.1.27): $\theta = ...$

Pg. 340, 2nd line: $[K] \{q\} = \{Q\}$. (i.e. delete repeated terms)

Pg. 344, eq. (6.1.37):

$$... = \mathcal{K}_{nj} = \int_0^L EI \frac{d^2 \psi_j}{dx^2} \frac{d^2 \psi_n}{dx^2} dx +...$$

$$... = \mathcal{C}_{nj} = \int_0^L \left[ \gamma EI \frac{d^2 \psi_j}{dx^2} \frac{d^2 \psi_n}{dx^2} + c_v \psi_j \psi_n \right] dx + ...$$

Pg. 349, 4 th line of Matlab commands: ...*psi(n)* H, y, 0, 1)

Pg. 409, Exercise 6.17, 7th, 8th, and 9th lines: where $\omega$ is 95% and 105% of the fundamental and second natural frequencies, plot the ...

Pg. 409, Exercise 6.19, insert at end of last sentence: ...at midspan as a function of $\omega$.

Pg. 410, Exercise 6.27, last line: $k = 2000EI/L^3$.

Pg. 413, Exercise 6.56, reword 1st sentence: When a cantilerbeam is modeled by a certain Ritz series, the inertia ...

Pg. 440, first figure: change + to 4 in vertical axis.

Pg. 444, 2nd equation: $(\psi_j(x))_{\text{asymptotic}} = ...$ Also, insert close brace at end of equation.

Pg. 445, 2nd line of text: ... by letting $1/\cosh(\alpha) = 0$. This...
Pg. 445, 4th line of equation for \( B_4 \):

\[
= C_1 \lim_{\alpha_j \to \infty} \{2[\sin (\alpha_j) - ...]\}
\]

Pg. 449, line following equation for \( \psi \): where \( \alpha^4 = \rho AL^4 \omega^2 / EI \)

Pg. 453, Figure 7.12: Spring force on the right mass should be \( k \frac{w}{x = L} \)

Pg. 455, 2 lines before eq. (7.6.26): ... are not inertially coupled. Interestingly...

Pg. 464, 4th equation, 2nd line: insert close brace at end of equation

Pg. 481, 4th line of equations: \( \exp(-kL) = 1/\varepsilon_1, \ \exp(-0.8kL) = 1/\varepsilon_2 \)

Pg. 494, eq. (7.9.40), 2nd line:

\[
-\frac{1}{2} \sum_j \sum_n \left[ \int_0^L (\rho A \Psi_{wj} \Psi_{wn} + \rho I \Psi_{wj} \Psi_{wn}) \, dx \right] \dot{\eta}_j \dot{\eta}_n
\]

Pg. 495, 10 lines before end of Example 7.14: ... function of \( \alpha, L, d, \) and \( \sigma \)

Pg. 496, 1st line: cross-section rotation \( \chi \) at this frequency....

Pg. 501, Exercises 7.25 and 7.26, insert at beginning of second sentence: Use Appendix C to decompose ...

Pg. 501, Exercise 7.29, 2nd line: Example 7.5 and Exercise 7.12. What...

Pg. 501, Exercise 7.33, change second sentence to: A torque \( \Gamma h(t) \) is applied at the midpoint.

Pg. 503, Exercise 7.52, last line: range \( 0 < \omega < 2000 \) rad/s

Pg 513, equation for \([K^e]\): The denominators for \( K_{2,6}^e, K_{3,5}^e, K_{5,3}^e, \) and \( K_{6,2}^e \) should be \( L^2 \).

Pg. 520, 1st line: Once we have formed \( \hat{M}, \hat{K} \), and \( \{\hat{Q}\} \), we ...

Pg. 529, Exercise 8.6, 7th line: ...Derive linear interpolating functions ... Also, delete parenthetical last sentence.

Pg. 530, Exercise 5.16, 3rd line: ...Use a single finite element for bar \( BD \),

Pg. 539, 2nd line of equations: \( a_{2(j+3N)} = 1 \),

Pg. 541, 3rd line of equation for \( V^1 \): index in first summation sign should be \( j \)

Pg. 544, eq. (9.1.31), 2nd line: \( = [B]^T \{Q\} + [B]^T [a]^T \{\lambda\} \)

Pg. 546: 3rd line of equations: \( M_{jn} = \frac{1}{2} \rho AL \delta_{jn} \)

Pg. 546: equation for \( V \), 2nd line: delete exponent two for \( q_j \) term

Pg. 546: equation for \( V \), 3rd line: delete exponent 2 and \( x \) from second factor

Pg. 546: equation for \( V \), 4th line: \( K_{jn} = \frac{j^4 \pi^4 EI}{2L^3} \delta_{jn} + ... \)
Pg. 556, 2nd equation: \( \psi^F_{w_j} = C^F_j \psi \left( \frac{x}{L^F}, \alpha_j \right) \)

Pg. 558, eq. (9.2.3):

\[
\begin{bmatrix}
K^F \\
K^F_{CC} \\
K^F_{CF} \\
K^F_{FF}
\end{bmatrix}
\]

Pg. 558, eq. (9.2.4), insert: \( [K^F]_{CF} = [K^F]_{FC}^T \)

Pg. 558, 1st sentence after eq. (9.2.4) should be: In the special case where the fixed-interface modes are those of a bar that is immobilized at both ends, the off-diagonal partitions of \( [K^F] \) are identically zero.

Pg. 558, last sentence of paragraph following eq. (9.2.4) should be: If \( \psi^F_{j} \) is defined to have zero displacement and rotation at interfaces, each work term will be zero.

Pg. 559, 4th line following eq. (9.2.6): eqs. (9.2.3). These matrices ...

Pg. 560, paragraph following equation for \( (K^F)_{CC} \), insert after second sentence: All \( (K^F)_{j_n} \) should evaluate to zero according to the note on page 558.

Pg. 564, Exercise 9.23, change second sentence: Determine the constraint modes and Jacobian constraint matrix corresponding to using clamped-clamped flexural modes as the fixed interface modes for bar \( AB \).

Pg. 564, Exercise 9.26, change 1st sentence: Select clamped-clamped flexural and fixed-free torsional modes as the fixed-interface ...

Pg. 572, 3rd line after 1st set of equations: eigenvalues to those derived from undamped modal analysis. Also, compare ...

Pg. 572, 3rd set of equations:

Mathcad: \( \text{zero} = \text{identity}(3) \times 0 \)

\[
S := \text{stack(augment}(-K, \text{zero}), \text{augment(zero, M)))}
\]

\[
R := - \text{stack(augment(zero, K), augment(K, C))}
\]

Pg. 572, 4th set of equations, insert after “MATLAB”: \( \lambda = \text{diag}(\lambda) \);

Pg. 572, 4th set of equations, 2nd line: \( \cdots + 0.0001 * (\text{imag}(\lambda(j)) < 0) ; \)

Pg. 592, Exercise 10.6, 2nd line, insert at end: ...to 16, and let \( \Delta f_j \) be a set of random numbers in the range \(-0.05 < \Delta f_j < 0.05\).

Pg. 598, 1st line after eq. (11.1.11): When the quadratic coefficients of \( T \) actually ...

Pg. 598, eq. (11.1.12), insert term: \( \cdots - \sum_{n=1}^{N} E_{jn} q_n + \hat{N}_j - J_j \)

Pg. 599, 1st line after eq. (11.1.16): ...use eqs (11.1.12) and (11.1.15) to form ...

Pg. 599, eq. (11.1.17), insert term: \( \cdots = \{Q\} - \{\hat{N}\} + \{J\} - \{F_0\} \)
Pg. 600, eq. (11.1.19), 2nd line, insert term: \[\{Q\} - \{\hat{N}\} + \{J\} - \{F_0\}\]

Pg. 600, eq. (11.1.21):

\[
[S] \frac{d}{dt} \{x\} - [R] \{x\} = \begin{cases} 0 \\ \{Q\} - \{\hat{N}\} + \{J\} - \{F_0\} \end{cases}
\]

Pg. 606, 1st line after eq. (11.2.1): ... into eq. (11.1.21) and ...

Pg. 607, 1st line after eq. (11.2.11): ... leads to \[\{v\} = \lambda \{u\}\], which ...

Pg. 620, eq. (11.4.13):

\[
n \bar{\xi}_o - \lambda \{\xi\} = \xi_n T \frac{1}{2} \{0\} + \{J\} - \{F_0\} \]

Pg. 621, eq. (11.4.17): Numerators should be \(\{\tilde{\Psi}_n\}^T \{F\}\) and \(\{\tilde{\Psi}_n\}^T \{F^*\}\)

Pg. 622, 3rd equation from bottom: \[-\omega^2 y_n - 2\omega \dot{z}_n\]

Pg. 622, 2nd equation from bottom: \[-\omega^2 z_n + 2\omega y_n\]

Pg. 623, 3rd set of equations from the bottom: 1st row of \(G'\) should be \(0 - \omega 0 0\)

Pg. 626, upper left graph: Delete the small circle at the top of the larger ellipse

Pg. 634, MATLAB program steps, 2nd and 3rd lines:

```matlab
eigval = eig(S(sig(j)), R(sig(j))); 
Re_lam(:,j) = sort(real(eigval)); 
Im_lam(:,j) = sort(imag(eigval)); 
end
```

Pg. 634, Mathcad program steps, 1st line: \(\lambda^{<j>} := \text{genvals}(R(\sigma_j), S(\sigma_j))\)

Pg. 635, 3rd paragraph, lines 4 and 5, and following equation: \(\exp(\lambda_n \tau)\)

Pg. 639, 4th equation:

\[
f_{jn} = \left( \frac{\partial \psi_n}{\partial x} \right) \bigg|_{x=L}
\]

Pg. 642, Exercise 11.4:

\[
T = \frac{1}{2} m L^2 \left[ \frac{1}{3} \dot{\theta}^2 + \left( 1 + \cos (\theta) + \frac{1}{3} \cos (\theta)^2 \right) \omega^2 \right] + \frac{1}{2} I T \omega^2
\]

Pg. 645, Exercise 11.23, 1st line: ... a height of \(2\ell/3\) above ..

Pg. 646, Exercise 11.27, insert after 2nd sentence: The rotation rate is \(\omega = 0.6 (k/m)^{1/2}\).

Pg 657, eq. (12.3.1): right sides are \(\varepsilon m \omega^2 \cos (\omega t)\) and \(\varepsilon m \omega^2 \sin (\omega t)\)

Pg. 665, last set of equations: \(M'_{33} = M'_{44} = \kappa_y^2, \ G'_{34} = -G'_{43} = 2\kappa_z^2 \Omega\)

Pg. 670, eq. (12.5.6), 2nd line: \(= \varepsilon m \omega^2 \cos (\omega t)\)
Pg. 670, eq. (12.5.6), 4th line: \[ ... = \varepsilon m \omega^2 \sin (\omega t) \]

Pg. 672, 7th line: ... has a parametric instability. Typical ...

Pg. 672, 3rd and 2nd lines from bottom: ...condition \( |\text{Im}(\lambda)| = 0 \) also approximates ...

Pg. 675, Exercise 12.11, part (c), delete last sentence, which begins with “Explain why ...”

Pg. 676, Exercise 12.15, insert after last sentence: The damping ratios are \( \zeta_E = \zeta_I = 0.01 \).

Pg. 685, Appendix B, entry for Free vibration: Insert plus sign at the beginning of the second line

Pg. 685, Appendix B, entry for Quadratic excitation, last line: insert close parentheses after \( \zeta^3 \)

Pg. 685, Appendix B, entry for Transient co-sinusoidal excitation, last line: fraction should be:

\[
\frac{\zeta \omega_{\text{nat}} \left( \omega_{\text{nat}}^2 + \omega^2 \right)}{\omega_d}
\]

Inside back cover, left page, first line: \( \omega_n = \left( \frac{E}{\rho L^2} \right)^{1/2} \alpha_n \)

Inside back cover, right page, entry for Clamped at \( x = 0 \), Clamped at \( x = L \), 1st line:

\[ \cos (\alpha) \cosh (\alpha) - 1 = 0 \]