<table>
<tr><th colspan="2">Space frame</th><th colspan="3">Transformation</th><th colspan="2">Body frame</th></tr>
<tr><th>Vector
(Cartesian space)</th><th>Lie algebra
(Tangent space)</th><th>from $\{b\}$ to $\{s\}$</th><th>Adjoint matrix</th><th>from $\{s\}$ to $\{b\}$</th><th>Lie algebra
(Tangent space)</th><th>Vector
(Cartesian space)</th></tr>
<tr>
<td>Spatial angular velocity
$\boldsymbol{\omega}_s$</td>
<td>$\dot{\mathbf{R}}\mathbf{R}^{-1} = [\boldsymbol{\omega}_s\times]$
$\dot{\mathbf{R}} = [\boldsymbol{\omega}_s\times]\,\mathbf{R}$
$\mathbf{R} = \exp\left([\boldsymbol{\omega}_s\times]\cdot\Delta t\right)$</td>
<td>$[\boldsymbol{\omega}_s\times] = \mathbf{R}\,[\boldsymbol{\omega}_b\times]\,\mathbf{R}^{-1} = [(\mathbf{R}\boldsymbol{\omega}_b)\times]$
$\boldsymbol{\omega}_s = \mathbf{R}\boldsymbol{\omega}_b$</td>
<td>$[\mathrm{Ad}_{\mathbf{R}}] = \mathbf{R}$
$\boldsymbol{\omega}_s = \mathbf{R}\boldsymbol{\omega}_b$
$[\mathrm{Ad}_{\mathbf{R}^{-1}}] = \mathbf{R}^{-1}$
$\boldsymbol{\omega}_b = \mathbf{R}^{-1}\boldsymbol{\omega}_s$</td>
<td>$[\boldsymbol{\omega}_b\times] = \mathbf{R}^{-1}\,[\boldsymbol{\omega}_s\times]\,\mathbf{R} = \left[\left(\mathbf{R}^{-1}\boldsymbol{\omega}_s\right)\times\right]$
$\boldsymbol{\omega}_b = \mathbf{R}^{-1}\boldsymbol{\omega}_s$</td>
<td>$\mathbf{R}^{-1}\dot{\mathbf{R}} = [\boldsymbol{\omega}_b\times]$
$\dot{\mathbf{R}} = \mathbf{R}\,[\boldsymbol{\omega}_b\times]$
$\mathbf{R}^{-1} = \exp\left([\boldsymbol{\omega}_b\times]\cdot\Delta t\right)$</td>
<td>Body angular velocity
$\boldsymbol{\omega}_b$</td>
</tr>
<tr>
<td>Spatial velocity
$\boldsymbol{\mathcal{V}}_s = \begin{bmatrix}\boldsymbol{\omega}_s\\ \mathbf{v}_s\end{bmatrix}$</td>
<td>$\dot{\mathbf{T}}\mathbf{T}^{-1} = \left[\boldsymbol{\mathcal{V}}_s^{\wedge}\right] = \left[\begin{array}{c|c}[\boldsymbol{\omega}_s\times] & \mathbf{v}_s\\ \hline \mathbf{0}^{\mathrm{T}} & 0\end{array}\right]$
$\dot{\mathbf{T}} = \left[\boldsymbol{\mathcal{V}}_s^{\wedge}\right]\mathbf{T}$
$\mathbf{T} = \exp\left(\left[\boldsymbol{\mathcal{V}}_s^{\wedge}\right]\cdot\Delta t\right)$</td>
<td>$\left[\boldsymbol{\mathcal{V}}_s^{\wedge}\right] = \mathbf{T}\left[\boldsymbol{\mathcal{V}}_b^{\wedge}\right]\mathbf{T}^{-1}$
$\boldsymbol{\mathcal{V}}_s = [\mathrm{Ad}_{\mathbf{T}}]\,\boldsymbol{\mathcal{V}}_b$</td>
<td>$[\mathrm{Ad}_{\mathbf{T}}] = \begin{bmatrix}\mathbf{R} & \mathbf{0}\\ [\mathbf{r}\times]\,\mathbf{R} & \mathbf{R}\end{bmatrix}$
$\boldsymbol{\mathcal{V}}_s = [\mathrm{Ad}_{\mathbf{T}}]\,\boldsymbol{\mathcal{V}}_b$
$[\mathrm{Ad}_{\mathbf{T}^{-1}}] = \begin{bmatrix}\mathbf{R}^{-1} & \mathbf{0}\\ -\mathbf{R}^{-1}[\mathbf{r}\times] & \mathbf{R}^{-1}\end{bmatrix}$
$\boldsymbol{\mathcal{V}}_b = [\mathrm{Ad}_{\mathbf{T}^{-1}}]\,\boldsymbol{\mathcal{V}}_s$</td>
<td>$\left[\boldsymbol{\mathcal{V}}_b^{\wedge}\right] = \mathbf{T}^{-1}\left[\boldsymbol{\mathcal{V}}_s^{\wedge}\right]\mathbf{T}$
$\boldsymbol{\mathcal{V}}_b = [\mathrm{Ad}_{\mathbf{T}^{-1}}]\,\boldsymbol{\mathcal{V}}_s$</td>
<td>$\mathbf{T}^{-1}\dot{\mathbf{T}} = \left[\boldsymbol{\mathcal{V}}_b^{\wedge}\right] = \left[\begin{array}{c|c}[\boldsymbol{\omega}_b\times] & \mathbf{v}_b\\ \hline \mathbf{0}^{\mathrm{T}} & 0\end{array}\right]$
$\dot{\mathbf{T}} = \mathbf{T}\left[\boldsymbol{\mathcal{V}}_b^{\wedge}\right]$
$\mathbf{T}^{-1} = \exp\left(\left[\boldsymbol{\mathcal{V}}_b^{\wedge}\right]\cdot\Delta t\right)$</td>
<td>Body velocity
$\boldsymbol{\mathcal{V}}_b = \begin{bmatrix}\boldsymbol{\omega}_b\\ \mathbf{v}_b\end{bmatrix}$</td>
</tr>
</table>