In[3]:=
```
RHS1 = {{ωx}, {ωy}, {ωz}};
RHS1 // MatrixForm
* This is the RHS of the equation 3.5 - 1 (The ω vector) *
```

Out[4]//MatrixForm=

$$\begin{pmatrix} \omega_x \\ \omega_y \\ \omega_z \end{pmatrix}$$

In[72]:=
```
rotmat =
  {{Sin[θ] * Sin[ϕ], 0, Cos[ϕ]}, {Sin[θ] * Cos[ϕ], 0, -Sin[ϕ]}, {Cos[θ], 1, 0}};
rotmat // MatrixForm
* rotmat is the rotation matrix for equation 3.5 - 1 *
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} \text{Sin}[\theta]\,\text{Sin}[\phi] & 0 & \text{Cos}[\phi] \\ \text{Cos}[\phi]\,\text{Sin}[\theta] & 0 & -\text{Sin}[\phi] \\ \text{Cos}[\theta] & 1 & 0 \end{pmatrix}$$

In[23]:=
```
(rotmat.RHS1) // MatrixForm
```

Out[23]//MatrixForm=

$$\begin{pmatrix} \text{Sin}[\theta]\,\text{Sin}[\phi]\,\omega_x + \text{Cos}[\phi]\,\omega_z \\ \text{Cos}[\phi]\,\text{Sin}[\theta]\,\omega_x - \text{Sin}[\phi]\,\omega_z \\ \text{Cos}[\theta]\,\omega_x + \omega_y \end{pmatrix}$$

```
angvel = {{OverDot[ψ]}, {OverDot[ϕ]}, {OverDot[θ]}};
angvel // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} \dot{\psi} \\ \dot{\phi} \\ \dot{\theta} \end{pmatrix}$$

In[54]:=
```
* Angular velocity vector *
```

In[24]:=
```
rotmat2 = Csc[θ] {{Sin[ϕ], Cos[ϕ], 0}, {-Sin[ϕ] * Cos[θ], -Cos[θ] * Cos[ϕ], Sin[θ]},
    {Cos[ϕ] * Sin[θ], -Sin[θ] * Sin[ϕ], 0}};
(Simplify[rotmat2]) // MatrixForm
```

Out[25]//MatrixForm=

$$\begin{pmatrix} \text{Csc}[\theta]\,\text{Sin}[\phi] & \text{Cos}[\phi]\,\text{Csc}[\theta] & 0 \\ -\text{Cot}[\theta]\,\text{Sin}[\phi] & -\text{Cos}[\phi]\,\text{Cot}[\theta] & 1 \\ \text{Cos}[\phi] & -\text{Sin}[\phi] & 0 \end{pmatrix}$$

```
* Rotation matrix for the equation 3.5 - 2 *
```

In[55]:=
```
Simplify[Inverse[rotmat]] // MatrixForm
```

Out[55]//MatrixForm=

$$\begin{pmatrix} \text{Csc}[\theta]\,\text{Sin}[\phi] & \text{Cos}[\phi]\,\text{Csc}[\theta] & 0 \\ -\text{Cot}[\theta]\,\text{Sin}[\phi] & -\text{Cos}[\phi]\,\text{Cot}[\theta] & 1 \\ \text{Cos}[\phi] & -\text{Sin}[\phi] & 0 \end{pmatrix}$$

In[56]:=
```
Simplify[Inverse[rotmat] == rotmat2]
```

Out[56]= True

* The inverse of rotmat is compared with rotmat2. Since they are equal, the two equations can be said to be same. *

In[49]:=
```
angvel = Inverse[rotmat].RHS1;
Simplify[angvel] // MatrixForm
```

Out[50]//MatrixForm=

$$\begin{pmatrix} \text{Csc}[\theta]\ (\text{Sin}[\phi]\ \omega_x + \text{Cos}[\phi]\ \omega_y) \\ -\text{Cot}[\theta]\ \text{Sin}[\phi]\ \omega_x - \text{Cos}[\phi]\ \text{Cot}[\theta]\ \omega_y + \omega_z \\ \text{Cos}[\phi]\ \omega_x - \text{Sin}[\phi]\ \omega_y \end{pmatrix}$$

In[54]:= * Angular velocity vector expression from the equation 3.5 – 1, by taking inverse of the rotation matrix *

In[51]:=
```
angvel2 = rotmat2.RHS1;
Simplify[angvel2] // MatrixForm
```

Out[52]//MatrixForm=

$$\begin{pmatrix} \text{Csc}[\theta]\ (\text{Sin}[\phi]\ \omega_x + \text{Cos}[\phi]\ \omega_y) \\ -\text{Cot}[\theta]\ \text{Sin}[\phi]\ \omega_x - \text{Cos}[\phi]\ \text{Cot}[\theta]\ \omega_y + \omega_z \\ \text{Cos}[\phi]\ \omega_x - \text{Sin}[\phi]\ \omega_y \end{pmatrix}$$

In[53]:= * Expression for equation 3.5 – 2 *

In[53]:=

In[53]:=
```
Simplify[angvel == angvel2]
```

Out[53]= True

In[54]:= * Proof that the 2 matrices are equal *

In[42]:=

In[ ]:=

In[ ]:=

In[ ]:=

In[ ]:=

In[ ]:=

In[ ]:=

In[ ]:=

In[ ]:=