$$\gamma_{w}\left(z\right)=w-z\overset{\ast}{w}z$$

$$x\in\Omega_{u}\colon\quad\hat{\gamma}_{w}\left(x\right)=2x\overset{\ast}{u}w$$

$$z\underline{\gamma}_{w}\left(u\right)=-2z\overset{\ast}{w}u\Longrightarrow\underline{\gamma}_{w}\left(u\right)=-2\overset{\ast}{w}u\Longrightarrow\underline{\gamma}_{w}\left(\overset{\ddagger}{u}\right)=2\overset{\ast}{u}w$$

$$\hat{\gamma}_{w}\left(x\right)-x\cdot\lambda_{w}=x\overset{\ast}{u}\,w_{1}+x\overset{\ast}{w}_{1}u$$

$$x\cdot\lambda_{w}=x\overset{\ast}{u}\overbrace{w_{1}+2w}^{\overset{\ast}{}}{}_{1/2}-x\overbrace{w_{1}+2w}^{\overset{\ast}{}}{}_{1/2}u=x\overset{\ast}{u}\overbrace{w_{1}+2w}^{\overset{\ast}{}}{}_{1/2}-x\overset{\ast}{w}_{1}u$$

$$\text{LHS}\;=2x\overset{\ast}{u}\overbrace{w_{1}+w}^{\overset{\ast}{}}{}_{1/2}-x\overset{\ast}{u}\overbrace{w_{1}+2w}^{\overset{\ast}{}}{}_{1/2}+x\overset{\ast}{w}_{1}u=\;\text{RHS}$$

$$\underbrace{\hat{\gamma}_{w}\left(u\right)-u\cdot\lambda_{w}}\barwedge u=w\barwedge u+u\barwedge w$$

$$\text{LHS}\;=\underbrace{u\overset{\ast}{u}\overbrace{w_{1}+\overset{\ast}{w}_{1}}^{\overset{\ast}{}}}\barwedge u=\overbrace{w_{1}+\overset{\ast}{w}_{1}}^{\overset{\ast}{}}\barwedge u=\;\text{RHS}$$