Modification for Position Spline in IMU Frame

Section II-C Position spline (equations (10) and (11)) is now represented in IMU frame:

$$
\begin{aligned}
{}^{w}\mathbf{p}_i(t) = {}^{w}\mathbf{p}_{c_j} + {}^{w}_{c_j}\mathbf{R}\,{}^{c}\mathbf{p}_i + t\mathbf{l}_j^p + t^2\mathbf{q}_j^p + t^3\mathbf{c}_j^p \\
{}^{w}\mathbf{p}_i(t_{j-1}) = {}^{w}\mathbf{p}_{i_{j-1}}
\end{aligned}
$$

Section II-D The acceleration prediction is unchanged since the additional term ${}^{w}_{c_j}\mathbf{R}\,{}^{c}\mathbf{p}_i$ in ${}^{w}\mathbf{p}_i(t)$ is not related to time.

Section II-F Velocity calculations (equation (18) and the following $\mathbf{l}_j^p$ equation) are updated to:

$$
\begin{aligned}
\mathbf{l}_j^p &= ({}^{w}\mathbf{p}_{c_{j-1}} + {}^{w}_{c_{j-1}}\mathbf{R}\,{}^{c}\mathbf{p}_i - {}^{w}\mathbf{p}_{c_j} - {}^{w}_{c_j}\mathbf{R}\,{}^{c}\mathbf{p}_i)/t_{j-1} - t_{j-1}\mathbf{q}_j^p - t_{j-1}^2\mathbf{c}_j^p \\
&= ({}^{w}\mathbf{p}_{c_j} + {}^{w}_{c_j}\mathbf{R}\,{}^{c}\mathbf{p}_i - {}^{w}\mathbf{p}_{c_{j+1}} - {}^{w}_{c_{j+1}}\mathbf{R}\,{}^{c}\mathbf{p}_i)/t_j + t_j\mathbf{q}_{j+1}^p + 2t_j^2\mathbf{c}_{j+1}^p
\end{aligned}
$$

Hence, the velocity continuity constraint (equation (19)) is updated to:

$$
\begin{aligned}
\mathbf{c}_v(j) = {} & ({}^{w}\mathbf{p}_{c_{j-1}} + {}^{w}_{c_{j-1}}\mathbf{R}\,{}^{c}\mathbf{p}_i - {}^{w}\mathbf{p}_{c_j} - {}^{w}_{c_j}\mathbf{R}\,{}^{c}\mathbf{p}_i)/t_{j-1} - t_{j-1}\mathbf{q}_j^p - t_{j-1}^2\mathbf{c}_j^p \\
& - ({}^{w}\mathbf{p}_{c_j} + {}^{w}_{c_j}\mathbf{R}\,{}^{c}\mathbf{p}_i - {}^{w}\mathbf{p}_{c_{j+1}} - {}^{w}_{c_{j+1}}\mathbf{R}\,{}^{c}\mathbf{p}_i)/t_j - t_j\mathbf{q}_{j+1}^p - 2t_j^2\mathbf{c}_{j+1}^p = \mathbf{0}
\end{aligned}
$$

Jacobians.pdf, Section III-A In addition to $\frac{\partial \mathbf{c}_v(j)}{\partial {}^{w}\mathbf{p}_{c_{j-1}}}$, $\frac{\partial \mathbf{c}_v(j)}{\partial {}^{w}\mathbf{p}_{c_j}}$, and $\frac{\partial \mathbf{c}_v(j)}{\partial {}^{w}\mathbf{p}_{c_{j+1}}}$, we augment the Jacobians with:

$$
\begin{aligned}
\frac{\partial \mathbf{c}_v(j)}{\partial {}^{w}_{c_{j-1}}\mathbf{R}} &= -\frac{1}{t_{j-1}} \cdot ({}^{w}_{c_{j-1}}\mathbf{R}\,{}^{c}\mathbf{p}_i)^{\wedge} \\
\frac{\partial \mathbf{c}_v(j)}{\partial {}^{w}_{c_j}\mathbf{R}} &= (\frac{1}{t_{j-1}} + \frac{1}{t_j}) \cdot ({}^{w}_{c_j}\mathbf{R}\,{}^{c}\mathbf{p}_i)^{\wedge} \\
\frac{\partial \mathbf{c}_v(j)}{\partial {}^{w}_{c_{j+1}}\mathbf{R}} &= -\frac{1}{t_j} \cdot ({}^{w}_{c_{j+1}}\mathbf{R}\,{}^{c}\mathbf{p}_i)^{\wedge}
\end{aligned}
$$