Upon solving the integral $\int_0^{\Delta s_j}(as_j+b)\frac{As_j+B}{s_j^2+Cs_j+D}ds_j$ in Python, the following solution was obtained:

$$-\left(\gamma_{j+1}-\gamma_j\right)\cos\left(\theta i-\theta j\right)-\left(\frac{\left(\left(-xi+\hat{x}i\right)\cos\left(\theta j\right)+\left(-yj+\hat{y}i\right)\sin\left(\theta j\right)\right)\left(\gamma j+1-\gamma j\right)}{2\Delta sj}+\frac{\left(\gamma j+1-\gamma j\right)\left(2\sin\left(\theta\right.\right.}{}\right.$$

$$\left(\frac{\left(\left(-xi+\hat{x}i\right)\cos\left(\theta j\right)+\left(-yj+\hat{y}i\right)\sin\left(\theta j\right)\right)\left(\gamma j+1-\gamma j\right)}{2\Delta sj}+\frac{\left(\gamma j+1-\gamma j\right)\left(2\sin\left(\theta j\right)yj-2\sin\left(\theta j\right)\hat{y}i+2\cos\left(\theta\right.\right.}{2\Delta sj}\right.$$

$$\left(\frac{\left(\left(-xi+\hat{x}i\right)\cos\left(\theta j\right)+\left(-yj+\hat{y}i\right)\sin\left(\theta j\right)\right)\left(\gamma j+1-\gamma j\right)}{2\Delta sj}+\frac{\left(\gamma j+1-\gamma j\right)\left(2\sin\left(\theta j\right)yj-2\sin\left(\theta j\right)\hat{y}i+2\cos\left(\theta\right.\right.}{2\Delta sj}\right.$$

$$\left(\frac{\left(\left(-xi+\hat{x}i\right)\cos\left(\theta j\right)+\left(-yj+\hat{y}i\right)\sin\left(\theta j\right)\right)\left(\gamma j+1-\gamma j\right)}{2\Delta sj}+\frac{\left(\gamma j+1-\gamma j\right)\left(2\sin\left(\theta j\right)yj-2\sin\left(\theta j\right)\hat{y}i+2\cos\left(\theta\right.\right.}{2\Delta sj}\right.$$