$$Q = \{q_1, q_2, \ldots, q_m\} | q_i = \{v_0, v_1, v_2, v_3\} \in \mathbb{R}^3, i = [1, m]$$
$$T = \{t_1, t_2, \ldots, t_k\} | t_j = \{v_0, v_1, v_2\} \in \mathbb{R}^3, j = [1, k]$$
$$A(p) = A(Q) + A(T)$$
$$A(p) = \frac{1}{2^m} \sum_{1 \le i \le m} 2^{m-1} A(q_i) + \sum_{1 \le j \le k} A(t_j)$$
$$A(p) = \frac{1}{2} \sum_{1 \le i \le m} A(q_i) + \sum_{1 \le j \le k} A(t_j)$$
$$A(p) = \frac{1}{2} \sum_{1 \le i \le m} [A(T_{i1}) + A(T_{i2}) + A(T_{i3})] + \sum_{1 \le j \le k} A(t_j)$$
$$\nabla A(p) = \nabla(\frac{1}{2} \sum_{1 \le i \le m} [A(T_{i1}) + A(T_{i2}) + A(T_{i3})] + \sum_{1 \le j \le k} A(t_j))$$
$$\nabla A(p) = (\frac{1}{2} \sum_{1 \le i \le m} [\nabla A(T_{i1}) + \nabla A(T_{i2}) + \nabla A(T_{i3})] + \sum_{1 \le j \le k} \nabla A(t_j))$$

$$\nabla A(T_{i1}) = \frac{\cot \alpha_{i3}(p_i - p) + \cot \alpha_{i2}(p_i' - p)}{2}$$
$$\nabla A(T_{i2}) = \frac{\cot \alpha_{j5}(p_i' - p) + \cot \alpha_{i4}(p_{i+1} - p)}{2}$$
$$\nabla A(T_{i3}) = \frac{\cot \alpha_{i6}(p_i - p) + \cot \alpha_{i1}(p_{i+1} - p)}{2}$$
$$\nabla A(t_j) = \frac{(\cot \alpha + \cot \beta)(p_j - p)}{2}$$
$$\nabla A(p) = \frac{1}{2} \sum_{1 \le i \le m} \left[\frac{\cot \alpha_{i3}(p_i - p) + \cot \alpha_{i2}(p_i' - p)}{2} + \frac{\cot \alpha_{j5}(p_i' - p) + \cot \alpha_{i4}(p_{i+1} - p)}{2} + \frac{\cot \alpha_{i6}(p_i - p) + \cot \alpha_{i1}(p_{i+1} - p)}{2} \right]$$
$$+ \sum_{1 \le j \le k} \frac{(\cot \alpha + \cot \beta)(p_j - p)}{2}$$
$$\nabla A(p) = \frac{1}{2} \sum_{1 \le i \le m} \left[\frac{(\cot \alpha_{i3} + \cot \alpha_{i6})(p_i - p) + (\cot \alpha_{i4} + \cot \alpha_{i1})((p_{i+1} - p))}{2} + \frac{(\cot \alpha_{i2} + \cot \alpha_{j5})(p_i' - p)}{2} \right]$$

$$+ \sum_{1 \le j \le k} \frac{(\cot \alpha + \cot \beta)(p_j - p)}{2}$$
$$\nabla A(p) = \frac{1}{4} \sum_{1 \le i \le m} (\cot \alpha_{i3} + \cot \alpha_{i6})(p_i - p) + (\cot \alpha_{i4} + \cot \alpha_{i1})((p_{i+1} - p))$$
$$+ \frac{1}{4} \sum_{1 \le i \le m} (\cot \alpha_{i2} + \cot \alpha_{j5})(p_i' - p)$$
$$+ \sum_{1 \le j \le k} \frac{(\cot \alpha + \cot \beta)(p_j - p)}{2}$$
$$\nabla A(p) = \frac{1}{4} \sum_{1 \le i \le m} (\cot \alpha_{i3} + \cot \alpha_{i6})(p_i - p)$$
$$+ \frac{1}{4} \sum_{1 \le i \le m} (\cot \alpha_{i4} + \cot \alpha_{i1})((p_{i+1} - p))$$
$$+ \frac{1}{4} \sum_{1 \le i \le m} (\cot \alpha_{i2} + \cot \alpha_{j5})(p_i' - p)$$
$$+ \sum_{1 \le j \le k} \frac{(\cot \alpha + \cot \beta)(p_j - p)}{2}$$

$$\nabla A(p) = \frac{1}{4} \sum_{1 \le i \le m} (\cot \alpha_{i3} + \cot \alpha_{i6})(p_i - p)$$

$$+\frac{1}{4}\sum_{1\le i\le m}(\cot\alpha_{(i-1)4}+\cot\alpha_{(i-1)1})((p_i-p))$$
$$+\frac{1}{4}\sum_{1\le i\le m}(\cot\alpha_{i2}+\cot\alpha_{j5})(p_i'-p)$$
$$+\sum_{1\le j\le k}\frac{(\cot\alpha+\cot\beta)(p_j-p)}{2}$$

$$\nabla A(p)=\frac{1}{4}\sum_{1\le i\le m}(\cot\alpha_{i3}+\cot\alpha_{i6}+\cot\alpha_{(i-1)4}+\cot\alpha_{(i-1)1})(p_i-p)$$
$$+\frac{1}{4}\sum_{1\le i\le m}(\cot\alpha_{i2}+\cot\alpha_{j5})(p_i'-p)$$
$$+\frac{1}{2}\sum_{1\le j\le k}(\cot\alpha+\cot\beta)(p_j-p)$$
$$\nabla A(p)=\sum_{1\le i\le m}w_i(p_i-p)+\sum_{1\le i\le m}w_i'(p_i'-p)+\sum_{1\le j\le k}w_j(p_j-p)$$