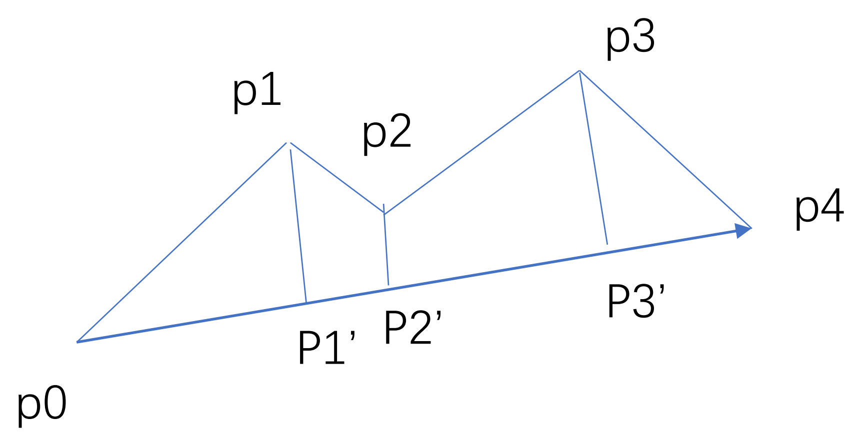
Direction-Preserving Trajectory Simplification

$$\triangle(\theta_1, \theta_2) = \min\{|\theta_1 - \theta_2|, 2\pi - |\theta_1 - \theta_2|\} \qquad (1)$$

$$\epsilon(\overline{p_{s_k} p_{s_{k+1}}}) = \max_{s_k \leq h < s_{k+1}} \triangle(\theta(\overline{p_{s_k} p_{s_{k+1}}}), \theta(\overline{p_h p_{h+1}}))$$

$$\epsilon(T') = \max_{1 \leq k < m} \epsilon(\overline{p_{s_k} p_{s_{k+1}}}) \qquad (2)$$

Closest Euclidean distance:



Algorithm SP:

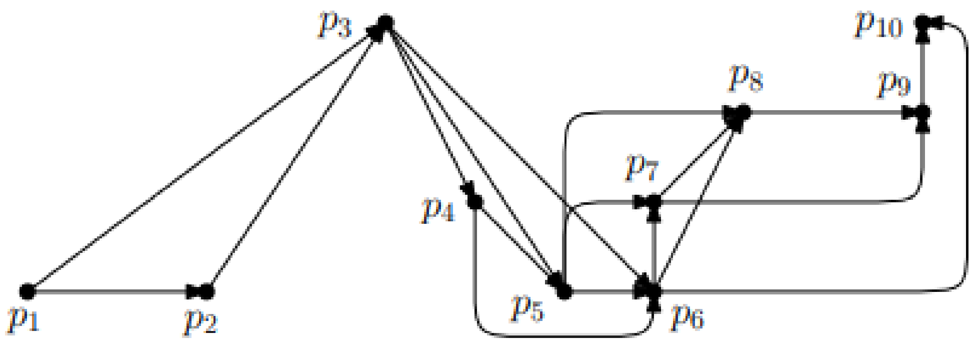


Figure 5: The graph G_{ϵ_t} constructed based on the running example when ϵ_t is set to be $\pi/4 = 0.785$

The SP algorithm with the practical enhancement:

Algorithm 1 The *SP* algorithm with the practical enhancement

Input: A trajectory $T = (p_1, p_2, ..., p_n)$ and the error tolerance ϵ_t

$H_0 \leftarrow \{p_1\}$; $U \leftarrow \{p_2, p_3, ..., p_n\}$; $l \leftarrow 1$
while *true* **do**
    $H_l \leftarrow \emptyset$
    //process the positions in H_{l-1} and U in a reversed order
    for each p_i in H_{l-1} and each p_j in U where $i < j$ **do**
        if $\epsilon(\overline{p_i p_j}) \leq \epsilon_t$ **then**
            if $p_j = p_n$ **then**
                return the trajectory corresponding to the shortest path from p_1 to p_n
            $U \leftarrow U \setminus \{p_j\}$; $H_l \leftarrow H_l \cup \{p_j\}$
    $l \leftarrow l + 1$

Trick!

Feasible direction range:

$$fdr(\overline{p_h p_{h+1}}|\epsilon_t) = [\theta(\overline{p_h p_{h+1}}) - \epsilon_t, \theta(\overline{p_h p_{h+1}}) + \epsilon_t] \mod 2\pi \tag{3}$$

$$fdr(T[i,j]|\epsilon_t) = \cap_{i \le h < j} fdr(\overline{p_h p_{h+1}}|\epsilon_t) \tag{4}$$

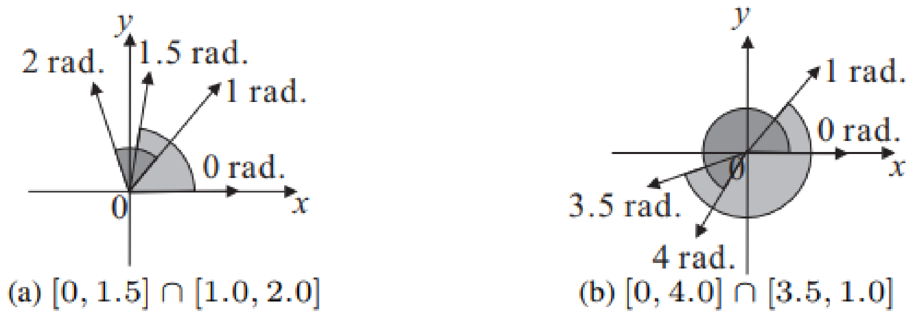


Figure 7: Illustration of intersection operations between two angular ranges

$||fdr(T[i,j])||$ *is bounded by* $\min\{1 + \lfloor \frac{\epsilon_t}{(\pi - \epsilon_t)} \rfloor, j - i\}$.

1,1	1,2	1,3	1,4
2,1	2,2	2,3	2,4
3,1	3,2	3,3	3,4
4,1	4,2	4,3	4,4

fdr(T[i, j])->fdr(T[i, j-1])->……

The intersect algorithm:

Algorithm 2 The *Intersect* Algorithm

Input: A trajectory $T = (p_1, p_2, ..., p_n)$; an error tolerance ϵ_t

Output: An ϵ_t-simplification of T'

$T' \leftarrow (p_1)$; $e \leftarrow 1$; $h \leftarrow 2$

while $h \leq n$ **do**

    while $h \leq n$ and $\overline{p_e p_h}$ is $\frac{\epsilon_t}{2}$-feasible **do**

        increment h by 1

    append p_{h-1} to T'; $e \leftarrow h - 1$

return T'