

## Erratum to: Dynamic path privacy protection framework for continuous query service over road networks

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The original version of this article unfortunately contained a mistake. Step 3 of Algorithm 2 (Select Anonymous Region Set Generation Algorithm) was incomplete and steps 4 to 6 were missing. The corrected Algorithm 2 is provided here.

The original article was corrected.

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The online version of the original article can be found at <http://dx.doi.org/10.1007/s11280-016-0403-3>.

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**Algorithm 2.** Select Anonymous Region Set Generation Algorithm

1. **Begin**
2. The temporal-spatial queue  $L_T$  is constructed, which each element in  $L_T$  links a request queue.
3. The Request Enqueue Algorithm is executed to generate a new request queue  $(U_{id}, \langle x, r \rangle, \langle R_{min}, R_{max}, k_s, t, k_t, pre \rangle, Content, *next, *pre)$  and this request queue is inserted into queue  $L_T$  in the chronological order, where  $s$  and  $t$  represent the space and time respectively.
4. Each element in queue  $L_T$  is searched, and multiple threads are generated according to the condition  $|T - T_s| < \delta$ , where  $T$  is the time when the element  $L$  in queue  $L$ ,  $T$  wants to generate the request queue,  $T_s$  is the current time of the running system, and  $\delta$  is the threshold. Each request queue is assigned to a thread.
5. Multiple threads are run in parallel, and each thread is responsible for the following operations.
  - 5.1 If the number of the elements in the request queue is smaller than  $k$ , the elements which satisfy the condition  $|T - T_s| < \delta$  are searched and those elements with priority  $pre$  are deleted to form request queue set  $\Omega$ . When  $\Omega$  is not empty, the density  $\rho$  of the user is queried by the communication service provider, anonymous region  $A$  and radius  $R_{xm}$  with the minimum anonymous request are computed, and the anonymous request set is generated by the radius  $R_{xm}$  and the centroid of all elements in set  $\Omega$ . The ID disturbing algorithm is executed to disturb the ID of the user and the anonymous request set is submitted to the location services server.
  - 5.2 If the number of the elements in the request queue is larger than  $k$ ,  $m$  threads are generated, where  $m$  is the number of elements in the request queue. Each thread executes the following operations.

- 5.3 If the three points  $(x_1, y_1)$ ,  $(x_2, y_2)$  and  $(x_3, y_3)$  in the anonymous range are located in a straight line, the coordinate of the center in the anonymous request set is  $(x_0 = (x_1 + x_2 + x_3)/3, y_0 = (y_1 + y_2 + y_3)/3)$ ; if not, the center of the circum of the triangle with coordinates  $(x_1, y_1)$ ,  $(x_2, y_2)$  and  $(x_3, y_3)$  is the center in the anonymous request set.
- 5.4 If  $R_{xm} \leq \min \{R_{\max}\}$ , a candidate anonymous region with circle center  $(x_0, y_0)$  and radius  $\min\{R_{\max}\}$  is generated.
- 5.5 Number  $s$  of the elements in the circle is computed, and the farthest point from the circle center and its distance  $D_{\max}$  are recorded. If  $s < k$ , then report failure.
- 5.6 If the number of the elements which satisfy the anonymous request is also smaller than  $k$ , then report failure.
- 5.7 If  $x_j - x_0 > 0$  and  $y_j - y_0 > 0$  then  $N_1 = N_1 + 1$ , if  $x_j - x_0 < 0$  and  $y_j - y_0 > 0$  then  $N_2 = N_2 + 1$ , if  $x_j - x_0 < 0$  and  $y_j - y_0 < 0$  then  $N_3 = N_3 + 1$ , and if  $x_j - x_0 > 0$  and  $y_j - y_0 < 0$  then  $N_4 = N_4 + 1, j = 1 \sim 3$ .
- 5.8 If each element within the circle satisfies the anonymous request, then  $\Delta = \min\{R_{\max}\} - D_{\max}$  is computed. If  $\Delta$  goes beyond the threshold, the radius of the circle is reduced until  $\Delta$  is in the threshold. Finally, the new radius  $R_0$  is obtained.
- 5.9 The anonymous region  $((x_0, y_0), R_0)$ , the set  $Q$  including all the request elements in this region and number  $N_Q$  of the elements in set  $Q$  are returned, and the density  $\rho = N_Q / (\pi R_0^2)$  of the users in the anonymous set is computed.
- 5.10 The ID disturbing algorithm is executed to disturb the ID of the user, set  $Q$  is submitted to the location service server, and queue  $L_T$  is renewed by the elements which are not in set  $Q$  and the location indexes are updated.

**6. End**