\( G(V, D, B) \): the input connected graph
\( A \): the set of already localized sensor nodes
(initially this set is the set of anchor nodes)

\[\text{while } (A \text{ does not contain all nodes)}\]
\[\text{identify nodes } a_i \in A \text{ from } G\]
\[\text{localize the sensor nodes in } N_{a_i} \text{ for } \forall a_i\]
\[N_a = \bigcup_i N_{a_i}\]
\[A \leftarrow A \cup N_a\]

\[\text{end}\]

Fig. 7. An algorithm to localize a spanning tree, used once for distances and a second time for bearings. \( N_{a_i} \) denotes the set of neighbors of node \( a_i \).

VI. EVALUATION OF LOCALIZATION IN RANDOM NETWORKS

We generate 20 instances of test networks each with 100 nodes by uniformly distributing the nodes in an area of 1000 \times 1000. We do not consider anchors, as we are interested here is how many nodes we can localize.

We consider three different measurement scenarios.

1) Distance-Bearing Measurements: We assume that each node can measure at least one distance and one bearing to a single node among its neighbors. As shown in Section V, connectivity of the network suffices to localize each node in the network. We raise the sensing radius of the network gradually until the largest connected component of the network contains all of the hundred nodes. We denote the resulting graph by \( G \).

2) Bearing-Only Measurements: We assume that each node can measure at least two bearings to two different neighbors. As shown in Section IV, creating \( G^2 \) from \( G \) of the network suffices to localize each node in the network. One way to achieve \( G^2 \) when \( G \) is the connected network at radius \( r(G) \) is to start with radius \( r(G) \) at each node, and then raise the sensing radius of each node individually so that it connects to all of its neighbors’ neighbors.

3) Distance-Only Measurements: We assume that each node can measure at least two distances to two different neighbors. As explained in Section III, creating \( G^3 \) from \( G \) of the network suffices to localize each node in the network. One way to achieve \( G^3 \) when \( G \) is the connected network at radius \( r(G) \) is to start with radius \( r(G) \) at each node, and then raise the sensing radius of each node individually so that it connects to all of its neighbors’ neighbors’ neighbors.

For each instance of the test networks, we compute the following performance metrics:

- \( r(G) \): We raise the sensing radius of the network gradually until the largest connected component of the network contains all of the \( N \) nodes resulting a graph denoted with \( G \). We refer to this radius as \( r(G) \).
- \( \bar{r}(G) \): We compute the average of the radii of all nodes in \( G \) and denote it by \( \bar{r}(G) \).
- \( n_G \): Total number of links in \( G \).