Algorithm 1: Hierarchical Paradigm with *Fuzzy* C-*means* (H1) in CMOMMT-URBAN3D

input : Perceptions of agents.
output : Decision making of the organization.

```
while t < Δt do
    if general coordinator then
        if t mod γ = 0 then
            Receives the message from the UAVs with their positions and their targets observed ;
            Execute FCM(iterations=10,dist = "euclidean",weights = 1, centers=UAV positions);
            Send a message to the UAVs with the new centers requested;
        end
    else
        if t mod γ = 0 then
            Sends a message to the general coordinator informing its position and targets observed;
            Receives from the general coordinator the action requested with the new centres;
            Moves in straight line to the new center nearest received;
        else
            Moves to the nearest center;
        end
    end
end
```

Algorithm 2: Hierarchical Paradigm with Kohonen Maps (H2) in CMOMMT-URBAN3D

input : Perceptions of agents.
output : Decision making of the organization.

```
while t < Δt do
    if general coordinator then
        if t mod γ = 0 then
            Receives the message from the UAVs with their positions and their targets observed ;
            Execute Kohonen(xdim = 4, ydim=3, iterations=1500, alpha = 0.08, top=hexagonal);
            Send a message to the UAVs with the new centers requested;
        end
    else
        if t mod γ = 0 then
            Sends a message to the general coordinator informing its position and targets observed;
            Receives from the general coordinator the action requested with the new centres;
            Moves in straight line to the new center nearest received;
        else
            Moves to the nearest center;
        end
    end
end
```

Algorithm 3: Dual Holarchy Paradigm (H3) in CMOMMT-URBAN3D

input : Perceptions of agents.
output : Decision making of the organization.

```
while t < Δt do
    if coordinator then
        if t mod γ = 0 then
            if general coordinator then
                Receives the message from the UAVs with their positions and their targets observed ;
                Send a message propagating the information to the coordinators Kohonen and FCM ;
            else
                if Kohonen holon coordinator then
                    Receives the message from the general coordinator; Execute Kohonen(xdim = 3,
                      ydim=2, iterations=1500, alpha = 0.08, top=hexagonal);
                    Send a message to the UAVs Kohonen with the new centers requested;
                else if FCM holon coordinator then
                    Receives the message from the general coordinator; Execute FCM(iterations=10,dist =
                      "euclidean",weights = 1, centers=UAV positions);
                    Send a message to the UAVs FCM with the new centers requested;
            end
        end
    else
        if t mod γ = 0 then
            if Kohonen UAVs then
                Sends a message to the general coordinator informing its position and targets observed;
                Receives from the coordinator of the holon Kohonen the action requested with the new
                  centres;
                Moves in a straight line to the new center Kohonen nearest received;
            else if FCM VANTs then
                Sends a message to the general coordinator informing its position and targets observed;
                Receives from the coordinator of the holon FCM the action requested with the new
                  centres;
                Moves in a straight line to the new center FCM nearest received;
        else
            Move to the center closest of your holon;
        end
    end
end
```

Algorithm 4: Triple Holarchy Paradigm (H4) in CMOMMT-URBAN3D

input : Perceptions of agents.
output : Decision making of the organization.

```
while t < Δt do
    if coordinator then
        if t mod γ = 0 then
            if general coordinator then
                Receives the message from the UAVs with their positions and their targets observed ;
                Send a message propagating the information to the coordinators Kohonen, FCM and DBSk;
            else
                if Kohonen holon coordinator then
                    Receives the message from the general coordinator; Execute Kohonen(xdim = 2, ydim=2, iterations=1500, alpha = 0.08, top=hexagonal);
                    Send a message to the UAVs Kohonen with the new centers requested;
                else if FCM holon coordinator then
                    Receives the message from the general coordinator; Execute FCM(iterations=10,dist = "euclidean",weights = 1, centers=UAV positions);
                    Send a message to the UAVs FCM with the new centers requested;
                else if DBSk holon coordinator then
                    Receives the message from the general coordinator; Execute DBSk(ϵ = r/1.5, MinPts = 2, K = 4, iterationsKM=10) ;
                    Send a message to the UAVs DBSk with the new centers requested;
            end
        end
    else
        if t mod γ = 0 then
            if Kohonen UAVs then
                Sends a message to the general coordinator informing its position and targets observed;
                Receives from the coordinator of the holon Kohonen the action requested with the new centres;
                Moves in a straight line to the new center Kohonen nearest received;
            else if FCM VANTs then
                Sends a message to the general coordinator informing its position and targets observed;
                Receives from the coordinator of the holon FCM the action requested with the new centres;
                Moves in a straight line to the new center FCM nearest received;
            else if DBSk UAVs then
                Sends a message to the general coordinator informing its position and targets observed;
                Receives from the coordinator of the holon DBSk the action requested with the new centres;
                Moves in a straight line to the new center nearest received DBSk;
        else
            Move to the center nearest of your holon;
        end
    end
end
```

Algorithm 5: Double Coalition Paradigm (C1) in CMOMMT-URBAN3D

input : Perceptions of agents.
output : Decision making of the organization.

```
while t < Δt do
    if position X of UAV between 0 and 75 then
        receive messages from coalition 1;
    else if position X of UAV between 76 and 150 then
        receive messages from coalition 2;
    if VANT belong the coalition1 then
        coalition1 leader ← draw(coalition1 UAVs) ;
        if coalition leader1 then
            if t mod γ = 0 then
                Receives the message from the UAVs of the coalition1 with their positions
                  and their targets observed;
                q ← Number of UAVs in coalition1;
                Execute Kohonen(xdim = q//2, ydim=2, iterations=1500, alpha = 0.08,
                  top=hexagonal);
                Sends a message to the UAVs of the coalition1 with the new centers
                  requested;
            end
        else
            Receives the message from the UAVs of the coalition1 with their positions and
              their targets observed;
            Send a message to the VANts of coalition1 informing its position and targets observed;
            Moves in a straight line to the new center Kohonen nearest received;
        end
    else if VANT belong the coalition2 then
        coalition leader2 ← draw(coalition UAVs2) ;
        if coalition leader2 then
            if t mod γ = 0 then
                Receives the message from the UAVs of the coalition2 with their positions and
                  their targets observed;
                q ← Number of UAVs in coalition2;
                Execute Kohonen(xdim = q/2, ydim=2, iterations=1500, alpha = 0.08,
                  top=hexagonal);
                Sends a message to the UAVs of the coalition2 with the new centers
                  requested;
            end
        else
            Receives the message from the UAVs of the coalition2 with their positions and
              their targets observed;
            Send a message to the UAVs of the coalition2 informing its position and targets
              observed;
            Moves in a straight line to the new center Kohonen nearest received;
        end
end
```

Algorithm 6: Quadruple Coalition Paradigm (C2) in CMOMMT-URBAN3D

input : Perceptions of agents.
output : Decision making of the organization.

```
while t < Δt do
    if position X of UAV between 0 and 75 and position Y of UAV between 0 and 75 then
        receive messages from coalition 1;
    else if position X of UAV between 76 and 150 and position Y of UAV between 76 and 150 then
        receive messages from coalition 2 ;
    else if position X of UAV between 76 and 150 and position Y of UAV between 0 and 75 then
        receive messages from coalition 3;
    else if position X of UAV between 0 and 75 and position Y of UAV between 76 and 150 then
        receive messages from coalition 4 ;
    if VANT belong the coalition1 then
        coalition1 leader ← draw(coalition1 UAVs) ;
        if coalition leader1 then
            if t mod γ = 0 then
                Receives the message from the UAVs of the coalition1 with their positions and their
                  targets observed;
                q ← Number of UAVs in coalition1;
                Execute Kohonen(xdim = q//2, ydim=2, iterations=1500, alpha = 0.08, top=hexagonal);
                Sends a message to the UAVs of the coalition1 with the new centers requested;
            end
        else
            Receives the message from the UAVs of the coalition1 with their positions and their
              targets observed;
            Send a message to the UAVs of coalition1 informing its position and targets observed;
            Moves in a straight line to the new center Kohonen nearest received;
        end
    else if VANT belong the coalition2 then
        coalition leader2 ← draw(coalition UAVs2) ;
        if coalition leader2 then
            if t mod γ = 0 then
                Receives the message from the UAVs of the coalition2 with their positions and their
                  targets observed;
                q ← Number of UAVs in coalition2;
                Execute Kohonen(xdim = q//2, ydim=2, iterations=1500, alpha = 0.08, top=hexagonal);
                Sends a message to the UAVs of the coalition2 with the new centers requested;
            end
        else
            Receives the message from the UAVs of the coalition2 with their positions and their
              targets observed;
            Send a message to the UAVs of the coalition2 informing its position and targets observed;
            Moves in a straight line to the new center Kohonen nearest received;
        end
    else if VANT belongr a coalition3 then
        coalition leader3 ← draw(coalition UAVs3) ;
        if coalition leader3 then
            if t mod γ = 0 then
                Receives the message from the UAVs of the coalition3 with their positions and their
                  targets observed;
                Execute FCM(iterations=10,dist = "euclidean",weights = 1, centers=UAV positions);
                Send a message to the UAVs of the coalition3 with the new centers requested;
            end
        else
            Receives the message from the UAVs of the coalition3 with their positions and their
              targets observed;
            Send a message to the UAVs of the coalition3 informing its position and targets observed;
            Moves in a straight line to the new center FCM nearest received;
        end
    else if VANT belong the coalition4 then
        coalition leader4 ← draw(coalition UAVs4) ;
        if coalition leader4 then
            if t mod γ = 0 then
                Receives the message from the UAVs of the coalition4 with their positions and their
                  targets observed;
                Execute FCM(iterations=10,dist = "euclidean",weights = 1, centers=UAV positions);
                Sends a message to the UAVs of the coalition3 with the new centers requested;
            end
        else
            Receives the message from the UAVs of the coalition4 with their positions and their
              targets observed;
            Send a message to the UAVs of the coalition4 informing its position and targets observed;
            Moves in a straight line to the new center FCM nearest received;
        end
end
```

Algorithm 7: Dual Federation Paradigm (F1) in CMOMMT-URBAN3D

input : Perceptions of agents.
output : Decision making of the organization.

```
while t < Δt do
    if number of targets observed by UAV < 2 then
        receive messages from explorer federation;
    else if number of targets observed by UAV > 1 then
        receive messages from federation observer;
    if VANT belong the observer federation then
        if t mod γ = 0 then
            if federation delegate then
                Receives the message from the UAVs of the federation and from the delegate of the explorer federation with the positions and targets observed;
                q ← Number of UAVs in the observer federation ;
                Execute Kohonen(xdim = q//2, ydim=2, iterations=1500, alpha = 0.08, top=hexagonal);
                Sends a message to the UAVs of the observer federation with the requested new centres;
            else
                Send a message to the delegate of the observing federation informing its position and targets observed;
                Receives from the delegate of the observer federation the action requested with the new centres;
                Moves in a straight line to the new center nearest Kohonen ;
            end
        end
    else if VANT belong the explorer federation then
        if t mod γ = 0 then
            if explorer federation delegate then
                Sends a message from the UAVs of the explorer federation with their positions and their targets observed to the delegate of the explorer federation;
            else
                Send a message to the delegate of the exploring federation informing its position and targets observed;
                moves randomly exploring the environment;
            end
        end
end
```

Algorithm 8: Triple Federation Paradigm (F2) in CMOMMT-URBAN3D

input : Perceptions of agents.
output : Decision making of the organization.

while $t < \Delta t$ **do**
  if *number of targets observed by UAV* < 2 **then**
    receive messages from explorer federation;
  else if *number of targets observed by UAV* > 1 *and* $=< 3$ **then**
    receive messages from observer federation;
  else if *number of targets observed by UAV* > 4 **then**
    receive messages from federation guard;
  if *VANT belong the observer federation* **then**
    if t *mod* $\gamma = 0$ **then**
      if *federation delegate* **then**
        Receives the message from the UAVs of the federation and from the delegate of the explorer federation with the positions and targets observed;
        q ← Number of UAVs in the observer federation ;
        Execute Kohonen(xdim = q//2, ydim=2, iterations=1500, alpha = 0.08, top=hexagonal);
        Sends a message to the UAVs of the observer federation with the new centers requested;
      else
        Send a message to the delegate of the observing federation informing its position and targets observed;
        Receives from the delegate of the observer federation the action requested with the new centres;
        Moves in a straight line to the new center nearest Kohonen ;
      end
      else
        move randomly;
      end
    end
  else if *VANT belong the explorer federation* **then**
    if t *mod* $\gamma = 0$ **then**
      if *explorer federation delegate* **then**
        Send the message from the UAVs of the explorer federation with their positions and their targets observed to the delegate of the explorer federation and guard ;
      else
        Send a message to the delegate of the exploring federation informing its position and targets observed;
        moves randomly exploring the environment;
      end
    end
  else if *VANT belong the guard federation* **then**
    if t *mod* $\gamma = 0$ **then**
      if *guard federation delegate* **then**
        Sends a message from the UAVs of the federation guard with their positions and their targets observed to the delegate of the federation observer;
      else
        Sends a message to the federation delegate guard informing its position and targets observed;
        does not move in the environment;
      end
    end
end

Algorithm 9: Collision Detection for UAVs in CMOMMT-URBAN3D

input : Destination position of the UAV.
output : Position corrected if necessary.

for *UAV* $\in$ *UAVs* **do**
  if *No destination position exists OR destination position is* $<$ *UAV speed* **then**
    Calculate a new random destination.
  end
  if *there is a block ahead* **then**
    Assign a new orientation between {North, South, East, West} that results in the smallest angular orientation offset.
  end
  if *there is no other UAV ahead* **then**
    advances to the destination point.
  end
end