# PANDASET LiDAR ANNOTATION INSTRUCTIONS

## Instructions

Annotate cuboids for the labels and attributes listed below according to the instructions below:

- **Minimum LiDAR Points:**
  - Label any target object containing at least 5 LiDAR points
  - Only label the object if you can be sure you know the location and shape of the object
  - Use your best judgment on correct cuboid position, sizing, and heading
  - **Exception:** For occluded or far away paths, you should label objects that contain at least 1 LiDAR point if you can accurately guess the correct size and location of the cuboid.
    - This exception should only apply if there is, at minimum, one frame where the same object has at least 5 LiDAR points.
    - Use images to ensure that you are identifying all far-away objects, and sizing cuboids to these objects.
- **Occlusion:**
  - If an object becomes occluded during a frame, draw a cuboid for the object during that frame if you can see at least 1 LiDAR point.
- **Cuboid Sizing:**
  - There should be no more than **20cm** of space between the cuboid border and the closest point on the object.
  - The cuboid must include all points belonging to the object.
  - Very small items that project off the object (such as **side view mirrors, items attached to the top of the vehicle**) should be left out of the cuboid.
    - See Pedestrian instructions for how to annotation people carrying or pushing objects
  - **Point drift or echo points**
    - Most LiDAR will return a type of error for static objects - where points drift off the front or back of a stationary object.

- When this occurs - fix the cuboid to the front-most points of the object, even when it is clear these are duplicate points. Size the cuboid to the frame with the most clear and dense point cloud.
- **Long Articulated Vehicles:**
    - Objects that are being towed by a car (e.g. boat, trailer, etc.) should be labeled as "Vehicles" using a separate cuboid from the towing vehicle
    - An articulated vehicle is one where there is a pivot joint between sections, which means that the two sections could turn in such a way that they are no longer facing the exact same direction
    - It's ok for these cuboids to overlap - include all of the towing vehicle and the towed object
    - Use a separate "Vehicle" label for each section of a long articulated vehicle (e.g. multi car trains, semi-trailer truck, etc.)
- **Heading**
    - Ensure heading is not off by more than 10 degrees in any frame
- **Labels Changing Mid-scene**
    - If an object requires two different labels throughout the scene, draw a new cuboid with a new label, and remove the cuboid with the old label.
        - For example: If a bicyclist gets off and begins to push their bicycle, remove the **Bicycle** cuboid and draw a two new cuboids: a **Pedestrian** cuboid for the pedestrian, and a **Personal Mobility** cuboid for the bicycle.

- **Taxonomy:**

| Class | Class Attribute |
|---|---|
| Car | Parked, Stopped, Moving |
| Pickup Truck | Parked, Stopped, Moving |
| Medium-sized Truck | Parked, Stopped, Moving |
| Semi-truck | Parked, Stopped, Moving |
| Towed Object | Parked, Stopped, Moving |
| Motorcycle | Parked, Stopped, Moving |

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|---|---|
| | With Rider, Without Rider |
| Other Vehicle - Construction Vehicle | Parked, Stopped, Moving |
| Other Vehicle - Uncommon | Parked, Stopped, Moving |
| Other Vehicle - Pedicab | Parked, Stopped, Moving |
| Emergency Vehicle | Parked, Stopped, Moving<br>Signaling, Not Signaling |
| Bus | Parked, Stopped, Moving |
| Personal mobility device | Parked, Stopped, Moving<br>With Rider, Without Rider |
| Motorized Scooter | Parked, Stopped, Moving<br>With Rider, Without Rider |
| Bicycle | Parked, Stopped, Moving<br>With Rider, Without Rider |
| Train | Parked, Stopped, Moving |
| Trolley | Parked, Stopped, Moving |
| Tram / Subway | Parked, Stopped, Moving |
| Pedestrian | Sitting, Lying, Walking, Standing<br>Child, Adult |
| Pedestrian with Object | Sitting, Lying, Walking, Standing<br>Child, Adult |
| Animals - Bird | In Air, On Ground |

| Animals - Other Animals | With Rider, Without Rider |
|---|---|
| Pylons | N/A |
| Road Barriers | N/A |
| Signs | N/A |
| Cones | N/A |
| Construction Sign | N/A |
| Temporary Construction Barriers | N/A |
| Rolling Containers | N/A |

# Labels

**Labels:**

| LABELS | DEFINITION | ATTRIBUTES | EXAMPLE |
|---|---|---|---|
| **Car** | Sedans, coupes, SUVs. | Parked, Stopped, Moving |  |

| Pickup Truck | Pickup trucks. | Parked, Stopped, Moving |  |
| --- | --- | --- | --- |
| **Medium-sized Truck** | Delivery vans, flatbed trucks or other trucks larger than a pickup truck and smaller than a semi-truck. | Parked, Stopped, Moving |  |
| **Semi-truck** | A six-wheeled trailer. When towing a trailer - label the trailer separately as a towed object. | Parked, Stopped, Moving |  |

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| **Towed Object** | Any object being towed, or any object that can be towed by a vehicle - e.g. a boat, trailer, semi-trailer other vehicle. | Parked, Stopped, Moving |  |
| **Motorcycle** | A motorcycle (two or three wheeled motor vehicle) with a rider or parked | Parked, Stopped, Moving |  |
| **Other Vehicle - Construction Vehicle** | A vehicle used for construction, e.g. an excavator, bulldozer, dump-truck. Does not include pickup trucks in a construction site. | Parked, Stopped, Moving |  |
| **Other Vehicle - Uncommon** | Any rare or unusual motorized vehicles that aren't covered by the other existing labels. This includes uncommon vehicles like meter-maids, tuk tuks, or street-sweepers | Parked, Stopped, Moving | |

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| **Other Vehicle - Pedicab** | A human-powered three wheel vehicle. | Parked, Stopped, Moving |  |
| **Emergency Vehicle** | An emergency response vehicle such as ambulance, police car or fire truck. | Parked, Stopped, Moving<br><br>Lights Flashing, Lights not Flashing | <br> |

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|---|---|---|---|
| **Bus** | Any bus; must have more than 3 axles Vans with 2 axles should be included in vehicle label. | Parked, Stopped, Moving |  |
| **Personal Mobility Device** | Any two or three wheeled non-motorized device that can be ridden by a person. This includes scooters, strollers, wheelchairs. Annotate the person riding the device and the device in one cuboid<br><br>When the object has no rider - draw a cuboid for the object and use the 'Without Rider' attribute. | Parked, Stopped, Moving | <br> |

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|---|---|---|---|
| **Motorized Scooter** | Motorized scooter. | Parked, Stopped, Moving |  |
| **Bicycle** | A two-wheeled vehicle powered by a person, with a rider or parked. | Stopped, Moving<br>With Rider, Without Rider |  |
| **Train** | Includes ONLY large train engines or cars attached to a large train. | Stopped, Moving |  |

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| **Trolley** | A trolley car - open air sides, operating on a city street. | Stopped, Moving |  |
| **Tram / Subway** | A single car or small vehicle traveling on rails through a city street or on a raised track. | Stopped, Moving |   |

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| **Pedestrian** | A person on foot, sitting or lying down.<br><br>Ensure that all points corresponding to the person are in the cuboid in all frames. Pedestrian arms / legs can swing, requiring cuboids be adjusted.<br><br>When a pedestrian is holding an object - e.g. a bag or a backpack -  use the 'Pedestrian with Object' label.<br><br>When a pedestrian is pushing a Personal Mobility Device, label the include that object in a separate cuboid. | Sitting, Lying, Walking, Standing<br><br>Child, Adult |  |
| **Pedestrian with Object** | A pedestrian holding an object, or carrying an object (e.g. a backpack or umbrella). Draw the cuboid to include the pedestrian and the object.<br><br>If the pedestrian is carrying an open umbrella - include the open umbrella in the cuboid. | Sitting, Lying, Walking, Standing<br><br>Child, Adult | <br> |

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| **Animals - Bird** | A bird, on the ground of in the air. | On Ground, In Air |   |
| **Animals - Other** | Any other animal visible in the point cloud. | N/A |   |

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| **Pylons** | Permanent short poles used for traffic guidance. These are fixed to the road. Use the image to confirm the class. | N/A |  |
| **Road Barriers** | Permanent barriers in the road, used for traffic guidance. Use the image to confirm the class. | N/A |  |
| **Signs** | Permanent signs used for traffic guidance; include the pole supporting the sign. Only include signs that directly influence traffic. Use the image to confirm the class. | N/A |  |

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|---|---|---|---|
| **Cones** | Non-permanent cone or short pole used for traffic guidance. Use the image to confirm the class. | N/A |  |
| **Construction Signs** | Non-permanent sign in or near the road, used for traffic guidance. Use the image to confirm the class. | N/A |  |
| **Temporary Construction Barriers** | Non-permanent barriers in the road, used for traffic guidance. Use the image to confirm the class. | N/A |  |

| Rolling Containers | Garbage cans on wheels, dumpsters or other containers that can move in or out of the road or sidewalk. | N/A |  |
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# Attributes

**Attributes:**

| ATTRIBUTE | SELECTIONS | DESCRIPTION | EXAMPLE |
| --- | --- | --- | --- |

| Object Motion | Parked Stopped Moving | Note whether an object is parked, stopped or moving. Parked objects will be on the side of the road or in a parking lot. Stopped objects will be in driveable space and / or will be moving in other frames. |  |

| Rider Status | With Rider<br>Without Rider | Note whether an object has a rider or not. In most cases an object without a rider will be parked, but not in all cases. |  |

| Emergency Vehicle Lights | Lights Flashing Lights not Flashing | Use the image to confirm if an emergency vehicles lights are flashing or not. |   |
| --- | --- | --- | --- |
| Pedestrian Behavior | Sitting Lying Walking Standing | Indicate the pedestrian's behavior - if they are sitting, lying down, standing still, walking. |  |

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| **Pedestrian Age** | Adult<br>Child | Use the image to indicate if the pedestrian is a child (less than ~18 years old) or an adult (older than 18). |  |
| **Bird Location** | In Air<br>On Ground | Indicate the bird is flying or on the ground. Use the z-index and image to annotate this attribute. |  |

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