**Coordinate System**

* Use a relative coordinate system based on the distance from a fixed point on the table. (For example, the bottom left corner of the table can be 0,0).
  + This was selected because if we have this quality of granularity in measurement. We can still choose to relay the location of the train according to a grid if needed to simplify the problem, but we cannot get further accuracy if all that we collected was grid information.

**Type of Data to Collect**

* Angle of Train from bottom corner of table
* Section of track
* Nearest junction
* Position within track
* Position
* Segments that a junction joins

**Train Geometry Collection Procedure**

Before you start geometry collection, partition the table into 4 sections along the length of the table where the Test Bed is located. Each section will be a phase of where data is collected. This intended to reduce the amount of work necessary for data collection at any one time, and to give us the opportunity to refine the geometry collection procedure before all of the table has been measured.

Tools

* Spreadsheet
  + Used to record the measurement data
* 3 Laser Range Finders
  + Position Measurement
* 3 Pedestals
  + Placement of Laser Range Finders
  + Ensures that Range Finders are High enough to avoid any interference from objects on the track.
* Fabric Tape Measure
* Measurement Rail Car
  + Rail car that has been fitted with two polls each with a marker on the top that is easy for the range finders to align and measure.
    - We need two markers so that we can estimate the orientation of the rail car.

**Setup**

* Divide table into 4 Regions Along the Length of the Table
* Mark the Beginning and End of Each Region
* Place RFID Tags On Each End of Each Section of Track that is within the region.
  + If there is a section of track that overlaps regions. Only add a tag for the end is with the region.
  + If there happens to be an end that overlaps the region of interest and another region, proceed with adding the tag.
* Select the Corner of the table that will be the origin of the coordinate system.
  + It is recommend to the bottom left corner so that all measurements are positive.
* Place pedestals on the corners of the table that are not the origin.
  + Pedestals are selected because the laser range finders must be level and they need to be high enough for us to be able to measured positions on the track without any risk of interference from objects on the train track.
* Mark on each pedestal. This will be the point where laser range finders will measure from.
  + It is recommended that you try to mark points as close to the table as possible.
* With the fabric tape measure, measure the distance from the origin of each of the measuring points.
  + You can also use a one of the laser range finders to measure distance at that point as well if desired.
  + This is necessary to make any last adjustments.
* Select one of the markers on the measurement rail car to be the primary marker.
  + The primary marker is the marker that is always aligned with the position of the object of interest when measuring.

**Procedure for a Given Partition of the Test Bed**

When searching for an object of interest that has not been measured yet, search from top-to-down and from left-to-right. The x-axis is the edge of the table that is along the length of the table and touches the origin. The y-axis is the edge of the table that is along the width of the table and touches the origin.

**Measuring the Position of an Object on the Track**

* Place or locate the object on the track that you want to measure.
* With the fabric tape measure, measure the distance from the object to the edge of the table that is perpendicular to the x-axis.
* With the fabric tape measure, measure the distance from the object to the edge of the table that is perpendicular to the y-axis.
* Move the measurement rail car into position so that the primary measurement marker of the car is aligned with the position on the track that is closest to the object of interest.
* Adjust the laser range finders on each pedestal so that the finders can measure the distance from the pedestal measurement point to a given measurement rail car measurement marker.
* Record the measurements of the distance from each range finder for each rail car measurement marker.
* Record the section of track that the object belongs to.
* If not already recorded, record the junctions that connect to the section of track.
* If not already recorded, record the two sections of track that are adjacent to the section of track that the object of interest is on.
* If measuring a RFID tag, record the end of the track section that it belongs to by recording the junction that it is closes to.
  + In the event, that the tag is not on an end of the track, record ‘NA’ so that it is known to be not be an end.

**Objects to Measure**

* RFID Tags
* Switches
* Junctions

NOTE: If we record just these things, then we know exactly where each section of track begins/ends. So we can use our train position data to estimate the geometry of each section of track when we begin position estimation.