Vehicle Dynamics

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1 Vehicle Modeling with Chronos

In this section we will develop and simulate vehicle model using the open source physics engine chronos

1.1 The Chrono::Vehicle library

The Chrono::Vehicle is a C++ middleware library for the modeling, simulation, and visualization of wheeled and tracked ground vehicles. It consists of two core modules:

- The ChronoEngine_vehicle
  - Defines the system and subsystem base classes
  - Provides concrete, derived classes for instantiating templates from JSON specification files
  - Provides miscellaneous utility classes and free functions for file I/O, Irrlicht vehicle visualization, steering and speed controllers, vehicle and subsystem test rigs, etc.
- The ChronoModels_vehicle
  - Provides concrete classes for instantiating templates to model specific vehicle models

The following dependencies should be satisfied in order to use the library.

- The Chrono::Engine required
- The Chrono:: Irrlicht and the Irrlicht library, Chrono::OpenGL and its dependencies. Both are optional
- The Chrono::FEA and Chrono::MKL (optional)

1.2 Setup simulation

Now that we went over the basics of the Chrono::Vehicle library let's try to set up a basic simulation; namely a vehicle that move in straight line.

$$\dot{y}\cos(\theta) - \dot{x}\sin(\theta) = 0 \tag{1}$$

So, our robot can roll forward and turn while rolling, but cannot move sideways directly. We'll use this constraint to define a kinematic model for our robot. The velocity of the robot is defined by the tangent vector to its path see figure ??.

References

[1] Åström K. J., Murray R. M. *Feedback Systems. An Introduction for Scientists and Engineers*

[2] Philip , Florent Altche1, Brigitte dAndrea-Novel, and Arnaud de La Fortelle *The Kinematic Bicycle Model: a Consistent Model for Planning Feasible Trajectories for Autonomous Vehicles?* HAL Id: hal-01520869, https://hal-polytechnique.archives-ouvertes.fr/hal-01520869

[3] Marcos R. O., A. Maximo *Model Predictive Controller for Trajectory Tracking by Differential Drive Robot with Actuation constraints*