User guide

MonteCarlo-MotorTeam-Sim

Requirements:

- Microsoft Windows 10 or newer, 32-bit
- LabVIEW 2020 Runtime

LabVIEW 2020 Runtime is required to run the executable file (.exe). Source VI codes made by LabVIEW 2020 (32-bit) are also distributed. LabVIEW 2020 system is required to run the distributed VI codes.

Contents:

- MonteCarlo-MotorTeam-Sim
  - builds
    - MonteCarlo_Team_Main
      - **MC_Team_Main.exe**...
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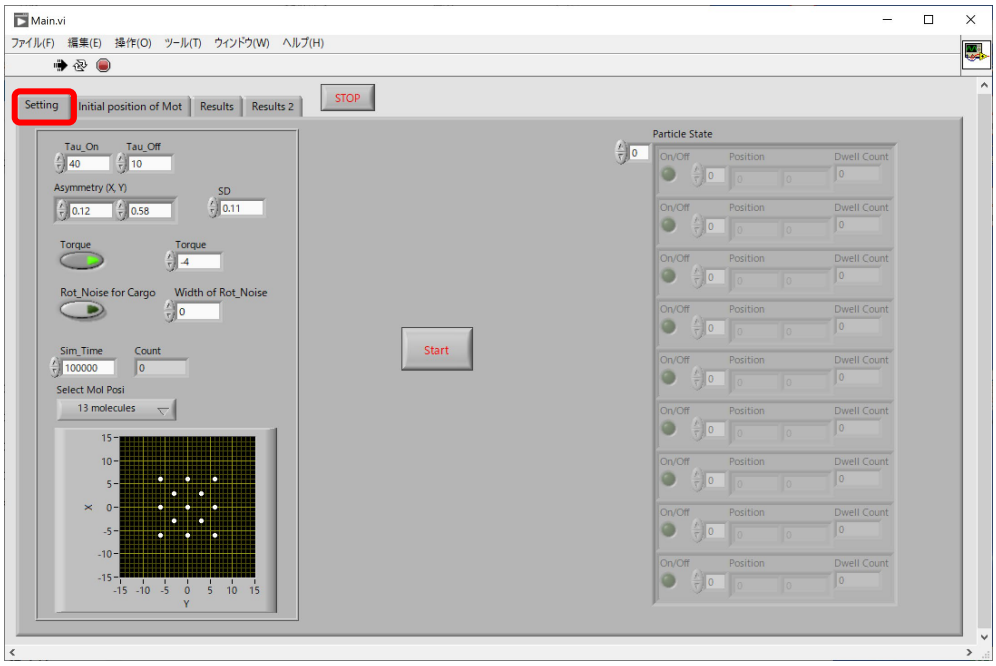
The executable file "***MC_Team_Main.exe***" is the main program of Monte-Carlo simulation of motor team with torque generation of motors in two dimensions.

The executable file "***MC_Team_Sidestep_Prob.exe***" is the program of Monte-Carlo simulation for evaluating the probability of successes of sidestepping a roadblock.

The folder "*MonteCarloMotorTeam_VI*" contains the source VI codes. The project file is "***MonteCarloMotorTeam.lvproj***".

How to run "MC-Team_main.exe"

1) Execute "**MonteCarlo-MotorTeam_main.exe**". The following window will pop up.



2) Set values of following parameters at Setting tab. **Default values are used in the paper.**

Tau_On : Lifetime of the attached state of motors on the lattice.

Tau_Off : Lifetime of the detached state of motors from the lattice.

Asymmetry(X, Y) : Set biased translational motion of motors in the XY-plane. The values of 0.5 results in random walk, while the values below 0.5 results in plus-directional biased motion.

SD : Standard deviation of the diffusion distribution of the detached motors.

Torque (button): Switch on/off torque generation by motors.

Torque (value): Twisting angle driven by torque generated by single motor.

Rot_Noise for Cargo (button) : Switch on/off rotational noise generation to a cargo.

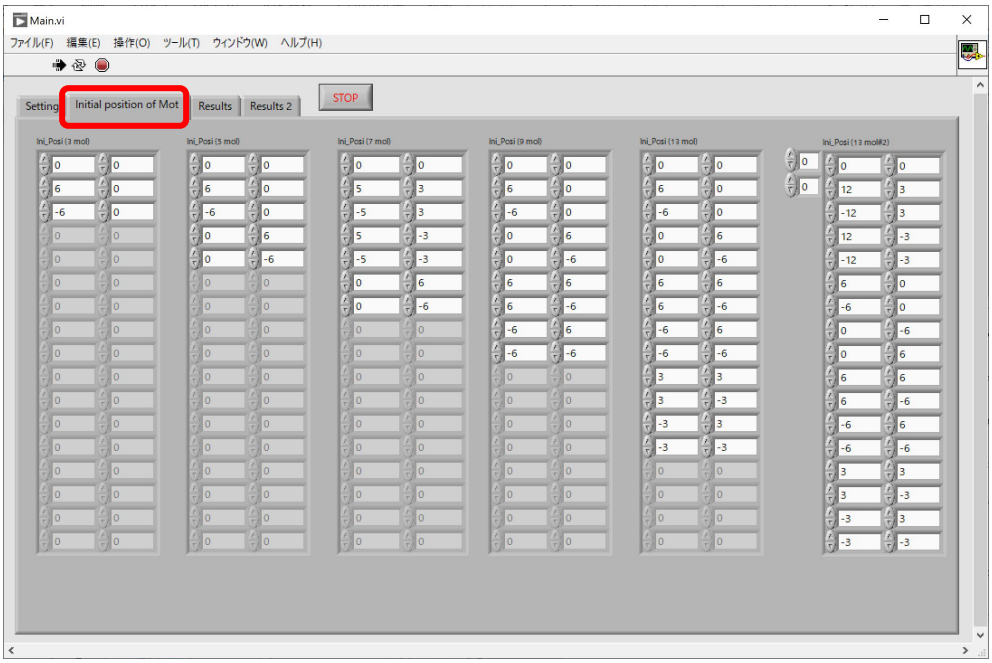
Width of RotNoise: Standard deviation of a rotational noise distribution.

Sim_Time : Set a simulation time.

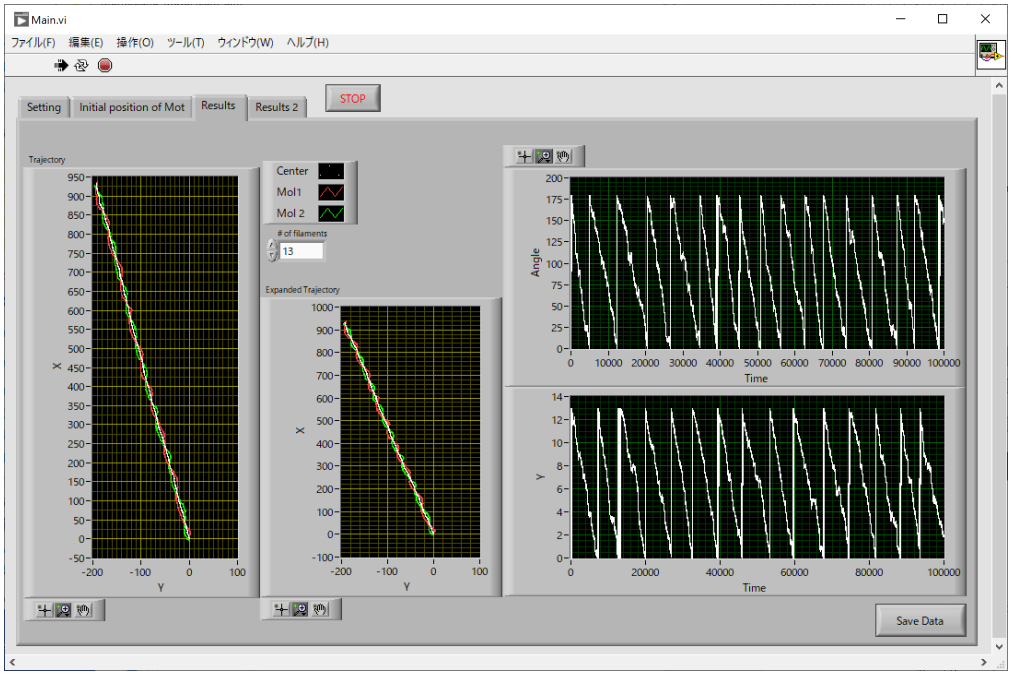
Select Mol Posi : Select the formation of motors from the list.

Start (button) : Start one simulation.

3) Formation of motors can be changed at the Initial position of Mot tag.



4) Simulation results will be shown in the Results tag.



Trajectory (left graph): Trajectories of the center of mass of motors, the front motor at the initial time, and the trailing motor at the initial time.

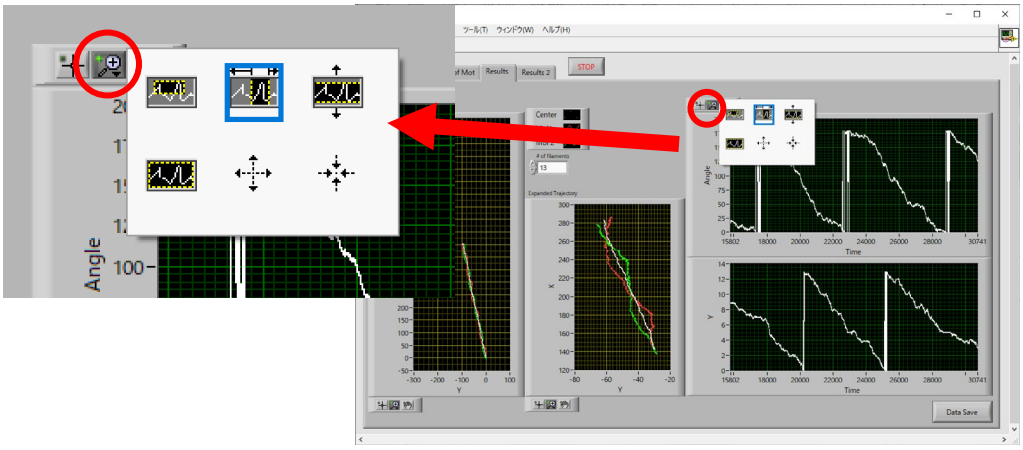
Expanded trajectory (middle graph): Trajectory limited in the range of time, in which the time trajectory of the angle (upper right graph) is shown.

Time vs. Angle (right upper graph): Time trajectory of the angle of the cargo converted to 180°-period.

Time vs. Y (right bottom graph): Time trajectory of the center of mass in 13-lattice period of the Y-displacement modeled as the 13-protofilament microtubules.

# of filaments : Select number of the lattice periods of the Y-displacement.

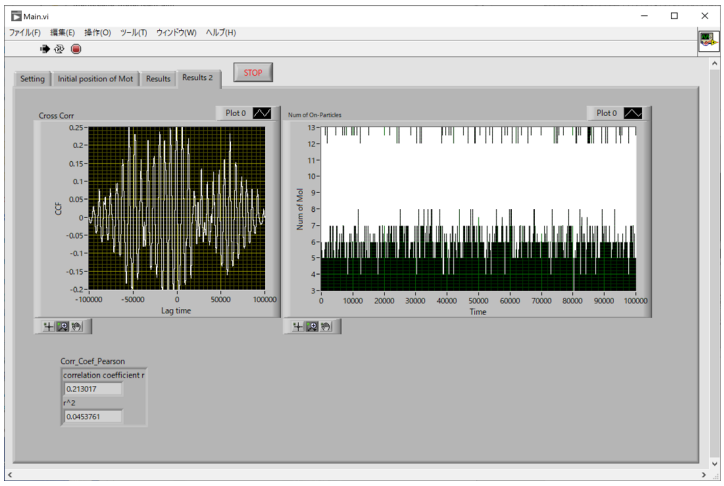
You can expand the Time vs. Angle. Two graphs, Time vs. Y and Expanded-trajectory follow the expansion.



Save Data (button): Save data which include time, XY-positions of the center of mass, the front motor at the initial time, the trailing motor at the initial time, the Y-displacement converted to 13-lattice period, the angle converted to 180°-period.

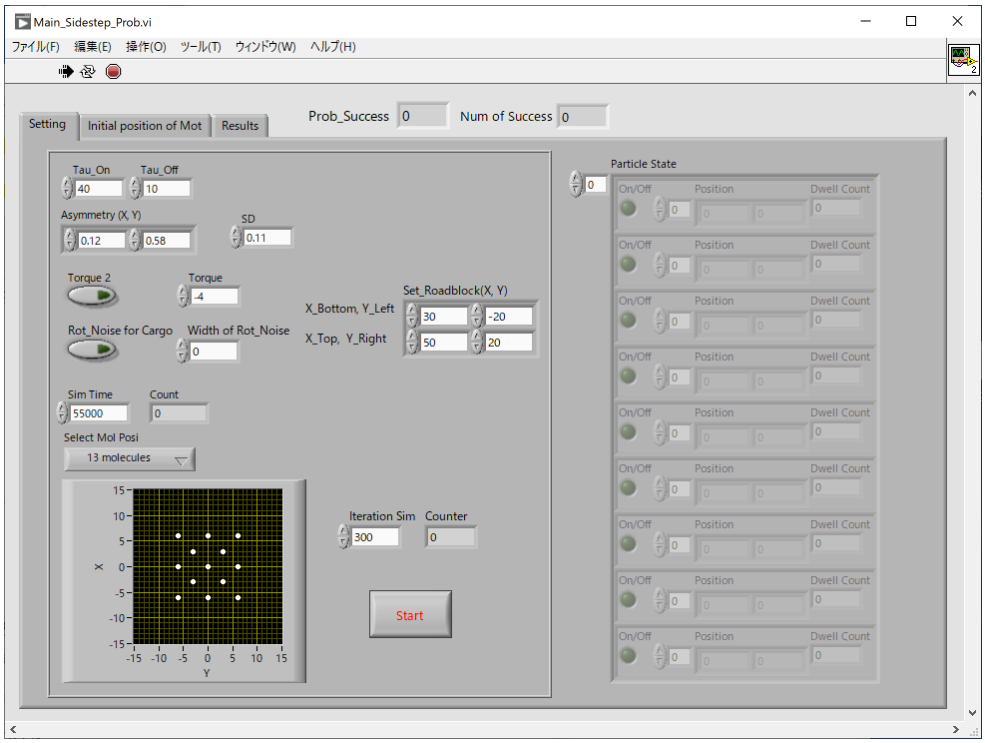
Stop (button) : End the program when you need not to save data.

5) The Results 2 panel shows a cross-correlation function between time-trajectories of the Y displacement and the angle, and a time-trajectory of number of motors in the on-state.



How to run "MC_Team_Sidestep_Prob.exe"

1) Execute "**MC_Team_Sidestep_Prob.exe**". The following window will pop up.



2) Set parameter values at Setting tab. **Default values are used in the paper.**

Tau_On : Lifetime of the attached state of motors on the lattice.

Tau_Off : Lifetime of the detached state of motors from the lattice.

Asymmetry(X, Y) : Bias of the translational motion of motors in the XY-plane. The values of 0.5 mean random walk, whilst the values below 0.5 results in plus-directional biased motion in the XY-plane.

SD : Standard deviation of diffusional motion of the detached motors.

Torque (button): Switch on/off torque generation by motors.

Torque (value): Twisting angle driven by torque generation by one motors.

Rot_Noise for Cargo: Switch on/off rotational noise for a cargo

Width of RotNoise: Standard deviation of rotational noise in Gaussian

Sim_Time: Simulation time.

Select Mol Posi: Select a formation of motors from the list. You can change the formation at the Initial position of Mot panel.

Set_Roadblock(X, Y) : 2×2 matrix of boundary positions of an obstruct.

$$\begin{pmatrix} X_{\mathrm{Bottom}} & Y_{\mathrm{Left}} \\ X_{\mathrm{Top}} & Y_{\mathrm{Right}} \end{pmatrix}$$

Iteration Sim : Number of iteration of simulation for evaluating probability of success of sidestepping the obstruct.

Start (button) : Start simulations.

2) The Results panel tab will be appeared for 2 seconds when each simulation ends.