

University of the Philippines
LOS BAÑOS

Simulation-Based Assessment of Banking Angle Effects on Electric Bike Lateral Stability Under Steady-State Conditions

Naomi Isabel M. Butac¹, James Frederic V. Espiritu¹, Carlos Emmanuel P. Garcia¹
Paolo Rommel P. Sanchez², Ralph Kristoffer B. Gallegos^{1,2}¹ Department of Mechanical Engineering, University of the Philippines Los Baños, College, Laguna, Philippines 4031² Institute of Agricultural and Biosystems Engineering, University of the Philippines Los Baños, College, Laguna, Philippines 4031

INTRODUCTION & AIM

In recent years, the number of consumers of three-wheeled vehicles has increased because of their practicality. However, along with the rise in demand comes a growing concern for safety, in terms of vehicle lateral stability during maneuvers. This highlights the need to understand the factors that influence stability, which this study addresses through multibody dynamics simulations.

This research aims to determine how banking angle affects lateral stability of e-bikes at banking angle from 0-10 degrees.



METHOD

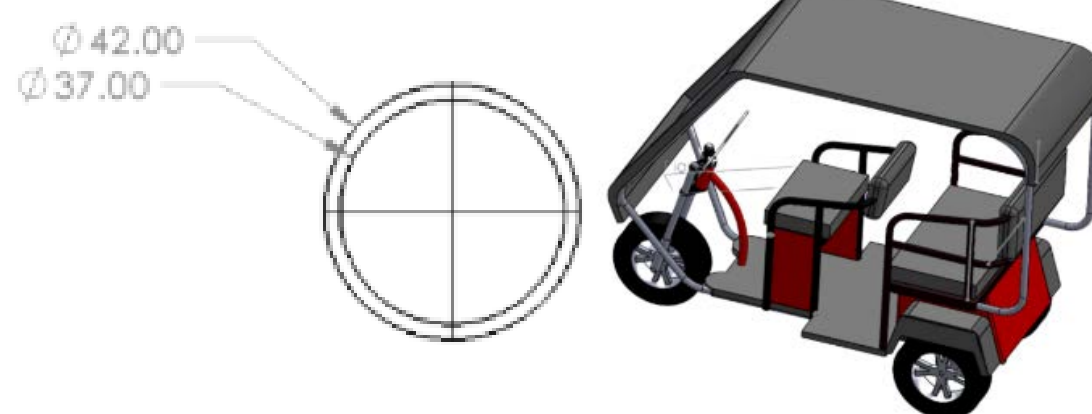
BEGIN

EXPERIMENTAL

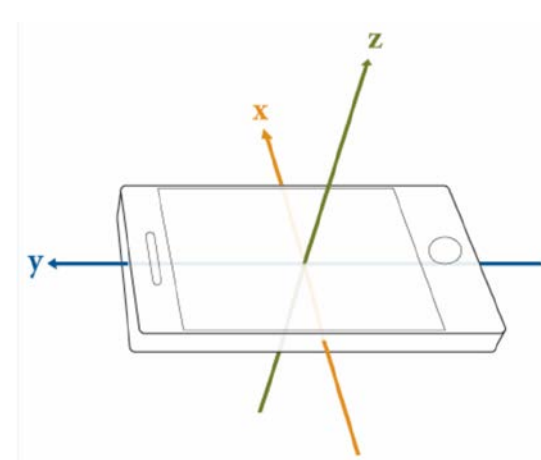
SIMULATION



Identify Vehicle Characteristics



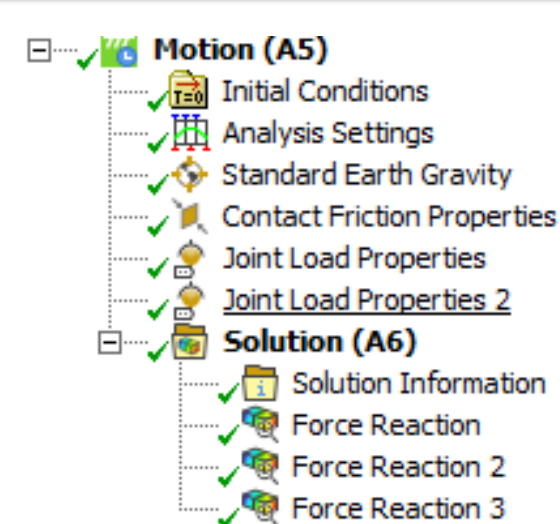
Modeling of Track and E-bike Based on Actual Measurements



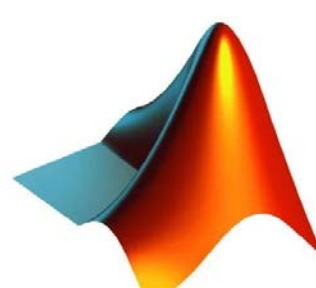
Preparation of Vehicle, Track and Equipment



Validation using Steady-state Circular Behavior

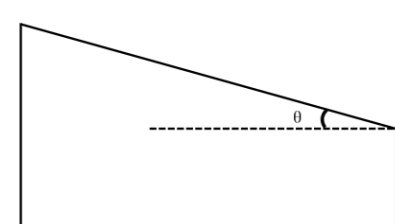


Solution: Setting up Boundary Conditions and Running the Simulation



MATLAB

Post-Processing: Viewing and Analyzing of Results



Vary the Banking Angle in the Road Design

$$SI = \frac{\sqrt{(\Sigma F_L)^2 + (\Sigma F_S)^2}}{\mu(\Sigma F_Z)} < 1$$

Determine Skid Index

No

Is the error less than 20%

Yes

RESULTS & DISCUSSION

Static Validation:

1.) Mass: 0.0884%

2.) Forces on Wheels: 7.6568%

Dynamic Validation:

1.) Acceleration: 19.6278%

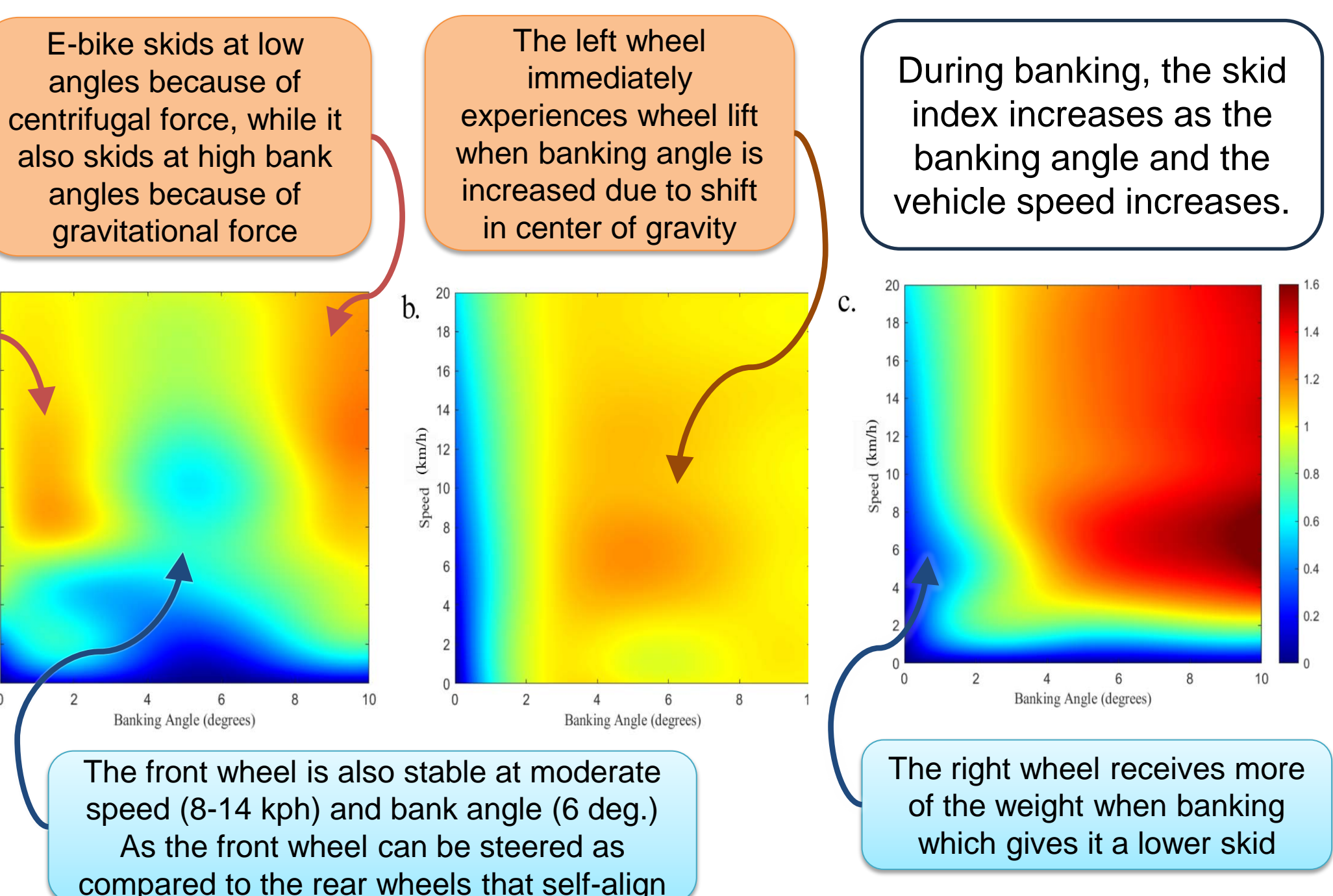
The results show that the static and dynamic models were validated as the solved percent difference between the actual and simulated set-up is limited to 19.628%.

DYNAMIC VALIDATION



Contour Plots of Skid Indices at Increasing Speed and Banking Angle

Front (a), Left Rear (b), and Right Rear (c) Wheel



CONCLUSION

With this, drivers and passengers should be aware that driving at high speeds during cornering, most especially on roads with high bank angles could lead to accidents. They should consider driving at speeds less than 12 km/h and on inclines less than 6° to avoid accidents.

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