

Dynamic Stability Assessment of Different Wheel Sized Bicycles Based on Current Frame Design Practice with ISO Requirement for Bicycle Safety

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Abstract : The difficulties in riding small wheel bicycles and their lesser stability have been perceived for a long time. Although small wheel bicycles are designed using the similar approach and guidelines that have worked well for big wheel bicycles, the performance of the big wheelers and the smaller wheelers are markedly different. Since both the big wheelers and small wheelers have same fundamental geometry, most blame the small wheel for this discrepancy in the performance. This paper reviews existing guidelines for bicycle design, especially the front steering geometry for the bicycle, and provides a systematic and quantitative analysis of different wheel sized bicycles. A validated mathematical model has been used as a tool to assess the dynamic performance of the bicycles in term of their self-stability. The results obtained were found to corroborate the subjective perception of cyclists for small wheel bicycles. The current approach for small wheel bicycle design requires higher speed to be self-stable. However, it was found that increasing the headtube angle and selecting a proper trail could improve the dynamic performance of small wheel bicycles. A range of parameters for front steering geometry has been identified for small wheel bicycles that have comparable stability as big wheel bicycles. Interestingly, most of the identified geometries are found to be beyond the ISO recommended range and seem to counter the current approach of small wheel bicycle design. Therefore, it was successfully shown that the guidelines for big wheelers do not translate directly to small wheelers, but careful selection of the front geometry could make small wheel bicycles as stable as big wheel bicycles.

Keywords : big wheel bicycle, design approach, ISO requirements, small wheel bicycle, stability and performance

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