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学位（博士）論文要旨

(Doctoral thesis abstract)

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論 文 題 目 (Title)	Vehicle Component Configuration Design and Packaging in Virtual Environment for Autonomous Electric Buses

論文要旨（2000 字程度）

The trend toward electrification and automation is revolutionizing the current public transportation system. Thus, the demand for autonomous electric buses increase globally. New vehicle models and variants increase the development complexity and hence the overall development time. Therefore, there is a requirement for a holistic vehicle configuration and packaging tool to generate and visualize vehicle concepts. The aim of this thesis is to develop a parametric tool called the Autonomous Electric Vehicle Tool (AEV Tool), for designing different concepts for electric autonomous buses of vehicle length between 4 m - 14 m. The scope of application is intended in the early phase of the vehicle development process to enable a fast and efficient creation of a flexible bus concept. The tool is designed with MATLAB and a Graphical User Interface (GUI) enables the user can input parameter data, which directly adjusts a parametric CAD (Computer Aided Design) model developed with CATIA software. The tool is implemented with two work modes namely, the manual mode and the

automated mode. The intuitive user interface allows the user to input basic vehicle parameters/ target specifications of the vehicle and could generate vehicle concepts instantly. In the manual mode, the overall vehicle dimensions, as well as the size of single components, can be changed, and different topology configurations can be chosen. For the automated mode, the vehicle specification is initiated by selection of one of the three classes of vehicle, the desired number of passengers and then the bus interior's seat arrangement design. Appropriate powertrain, chassis and the air conditioning components are then automatically configured based on several in-built component sizing and selection algorithms. The algorithms are developed as backend functions to work coherently with the inputs. A scalable life cycle assessment model is used to summarise the greenhouse gas emissions of the vehicle concept. The parametric tool is capable of deriving more than 100000 unique vehicle concepts in the manual mode and around 9600 different vehicle concepts in the automated mode of different passenger capacities, between 10 – 90 passengers. For evaluating the concepts, energy consumption is analysed through longitudinal dynamics simulations, and an estimated initial cost of vehicle concepts and individual systems completes the concept. A spider chart summarises all characteristics and offers an overview of the vehicle concept, providing the possibility to compare with different vehicle concepts simultaneously. The vehicle configuration results from the tool are validated based on the benchmark analysis and comparison with different studies. Several autonomous and electric buses in the market are used for validating the weight of vehicle concepts of different lengths. The influence of weight of subsystems are further investigated and validated. The initial vehicle and subsystem costs are validated by comparison of existing studies. The results of the weight and cost validation shows the reliability of the results from the tool. For a demonstration of overall applicability of the tool, the thesis finally presents a case study to demonstrate the impacts of replacing diesel buses with 6m AEVs on life-cycle costs and global warming potential for existing routes in Singapore.