2021年度
JARI 研究論文集

一般財団法人 日本自動車研究所

2021 年度
JARI 研究論文集
目次・アブストラクト

2021 年度 JARI 研究論文集　目 次

＜環境分野＞

(1) 2050 年の将来推計シナリオにおける大気環境 −自動車技術会 2050 年チャレンジと大気質予測−
森川 多津子 (JARI), 山田 裕之 (東京電機大), 田中 光太郎 (茨城大), 岡山 紳一郎 (日産自動車), 柴田 芳昭 (大気環境総合センター), 中田 泰正 (トヨタ自動車), 渡辺 宏江 (日産自動車), 木所 徹 (トヨタ自動車)
自動車技術会論文集　Vol.52, No.6, 2021 年 11 月
https://doi.org/10.11351/jsaeronbun.52.1261

(2) 自動車部門における統合対策を考慮した長期 CO2 排出量推計手法の開発
金成 修一, 平井 洋, 鈴木 徹也, 伊藤 晃佳 (JARI)
エネルギー・資源学会誌 Vol.43, No.2, 2022 年 3 月
https://doi.org/10.24778/jjser.43.2_53

(3) Measurement report: Source Characteristics of Water-soluble Organic Carbon in PM2.5 at Two Sites in Japan, as Assessed by Long-term Observation and Stable Carbon Isotope Ratio
Nana Suto (JARI), Hiroto Kawashima (Akita Prefectural Univ.)
Atmospheric Chemistry and Physics, Vol.21 (15), 2021 年 8 月
https://doi.org/10.5194/acp-21-11815-2021

(4) 30 Years of Air Quality Trends in Japan
Akiyoshi Ito (JARI), Shinji Wakamatu (Ehime Univ.), Tazuko Morikawa (JARI), Shinji Kobayashi (NIES)
Atmosphere, Vol.12, No.8, Special Issue "Air Pollution in Japan", 2021 年 8 月
https://doi.org/10.3390/atmos12081072

＜安全分野＞

(5) 自動車運転者の運転技量差に着目した交差点場面における自転車との潜在的な衝突リスクの分析
面田 雄一, 岩城 亮, 安部 原也 (JARI), 小川伯文 (自工会)
自動車技術会論文集, Vol.52, No.3, 2021 年 5 月
https://doi.org/10.11351/jsaeronbun.52.601

(6) 潜在的な事故危険場面通過時の走行速度適正化に向けた視覚情報提供の効果評価
山口 伊織, 北島 創, 安部 原也, 中村 弘毅 (JARI)
自動車技術会論文集, Vol.52, No.3, 2021 年 5 月
https://doi.org/10.11351/jsaeronbun.52.608

(7) 交通安全対策を念頭に置いたマレーシアの交通実態把握(第 2 報)
―四輪車直進走行時の前方二輪車挙動の分析―
川越 麻生, 今長 久 (JARI), 榎田 修一 (九州工業大), Azhar Bin Hamzah (MIROS), 石田 肇 (自工会)
自動車技術会論文集, Vol.52, No.3, 2021 年 5 月
https://doi.org/10.11351/jsaeronbun.52.707

(8) 運転行動に影響する車内音声タスクの要因に関する実験調査
宇野 宏 (JARI), 古賀光, 佐藤真平, 阿部正明 (自工会)
自動車技術会論文集, Vol.52, No.4, 2021 年 7 月

https://doi.org/10.11351/jsaeronbun.52.800

(9) 歩行中の子どもによる手つなぎ拒否と保護者の愛着・養育態度との関係

大谷 亮 (JARI)
応用心理学研究, Vol.47, No.2, 2021 年 11 月
https://doi.org/10.24651/oushinken.47.2_94

(10) 緊急場面におけるドライバの回避操作に関する研究
—オーバーラップ率が大きい場合の回避操作—

鈴木 崇, 若杉 貴志, 菊地 一範 (JARI), 千賀 雅明, 味村 寛, 占部 博之, 平田 直 (自工会)
自動車技術会論文集, Vol.53, No.1, 2022 年 1 月
https://doi.org/10.11351/jsaeronbun.53.71

(11) 一般年齢層のドライバを対象としたペダル踏み間違いに至る操作過程の分析

細川 崇, 橋本 博 (JARI), 平松 真知子, 石田 肇 (自工会)
自動車技術会論文集, Vol.53, No.2, 2022 年 3 月
https://doi.org/10.11351/jsaeronbun.53.264

(12) 高齢者の視認行動および認知支援による効果分析
–出会い頭交差点における対自転車事故防止に向けた検討–

中村 弘毅, 安部 原也 (JARI), 小川 伯文 (マツダ)
自動車技術会論文集, Vol.53, No.2, 2022 年 3 月
https://doi.org/10.11351/jsaeronbun.53.424

(13) Data Augmentation を用いた深層学習手法による歩行者衝突検知システムの検出率改善

國富 将平, 鮭川 佳弘 (JARI), 白川 正幸 (自工会)
自動車技術会論文集, Vol.53, No.2, 2022 年 3 月
https://doi.org/10.11351/jsaeronbun.53.391

(14) Application of Deep Learning Methods for Pedestrian Collision Detection using Dashcam Videos

Shouhei Kunitomi, Shinichi Takayama (JARI), Masayuki Shirakawa (JAMA)
Stapp Car Crash Journal, Vol. 64, 2021 年 4 月
https://doi.org/10.4271/2020-22-0008

(15) The Effect of Searback Inclination on Spinal Alignment in Automotive Seated Postures

Fusako Sato (JARI), Yusuke Miyazawa (Tokyo Institute of Technology),
Shigehiro Morikawa (Shiga Univ. of Medical Science),
Antonio Ferreiro Perez (Fundacione de Investigacion HM Hospitales),
Sylvi Schick (Ludwig-Maximilians-Univ. of Munich),
Karin Brolin (Chalmers Univ.), Mats Svensson (Chalmers Univ.)
Front. Bioeng. Biotechnol. Vol.2, 2021 年 8 月
https://doi.org/10.3389/fbioe.2021.684043

(16) Effects of Gender, Age, Experience, and Practice on Driver Reaction and Acceptance of Traffic Jam Chauffeur Systems

Husam Alzamili (JARI), Makoto Itoh, Cho Kiu Liang (Univ. of Tsukuba),
Jacobo Antona-Makoshi, Nobuyuki Uchida (JARI)

Scientific Reports, Vol.11, No.1, 2021 年 9 月
https://doi.org/10.1038/s41598-021-97374-5

(17) Defining Reasonably Foreseeable Parameter Ranges Using Real-World Traffic Data for Scenario-Based Safety Assessment of Automated Vehicles .....

Hiroki Nakamura, Husamu Muslim, Ryousuke Kato, Sandora Prefontaine-Watanabe, Hideo Nakamura, Hitoshi Kaneko, Hishashi Imanaga, Jacobo Antona-Makoshi, So Kitajima, Nobuyuki Uchida (JARI), Eiichi Kitamura, Koichiro Ozawa, Satoshi. Taniguchi (JAMA)

IEEE Access, Vol.10, 2022 年 3 月
https://doi.org/10.1109/ACCESS.2022.3162601

(18) Effect of Pedestrian Physique Differences on Head Injury Prediction in Car-to-pedestrian Accidents Using Deep Learning

Shouhei Kunitomi, Shinichi Takayama (JARI)

Traffic Injury Prevention, Vol.22, 2021 年 4 月
https://doi.org/10.1080/15389588.2021.1981886

※本研究論文集は，学協会等に発表した査読付き論文について，転載許可を得て掲載したものです．
リンク先の論文閲覧には料金がかかる場合、または会員のみ閲覧可能な場合がございます．

本年度から研究論文集は JARI 所員が第一執筆者の場合のみ掲載しております．

アブストラクト

＜環境分野＞

(1) 2050 年の将来推計シナリオにおける大気環境 −自動車技術会 2050 年チャレンジと大気質予測−

森川 多津子 (JARI), 山田 裕之 (東京電機大), 田中 光太郎 (茨城大), 岡山 紳一郎 (日産自動車), 柴田 芳昭 (大気環境総合センター), 中田 泰正 (トヨタ自動車), 渡辺 宏江 (日産自動車), 木所 徹 (トヨタ自動車)

自動車技術会論文集 Vol.52, No.6, 2021 年 11 月
https://doi.org/10.11351/jsaeronbun.52.1261

Based on an 80% reduction of greenhouse gases by 2050, the domestic air pollutant emission for 2050 was estimated. With the emission data and future estimation scenarios in mainland China, PM2.5 and O3 concentration were estimated by an air quality model: CMAQ (Community Multiscale Air Quality Modeling System). As a result, it was thought that the current atmospheric environmental quality standard would be achieved for PM2.5, and high-concentration photochemical O3 in summer would not occur. However, as the amount of decrease in O3 concentration in spring was small, it was considered that it would be difficult to achieve an air quality standard of 60 ppb.

(2) 自動車部門における統合対策を考慮した長期 CO2 排出量推計手法の開発

金成 修一, 平井 洋, 鈴木 徹也, 伊藤 晃佳 (JARI)

エネルギー・資源学会誌 Vol.43, No.2, 2022 年 3 月
https://doi.org/10.24778/jjser.43.2_53

The Japanese government announced its mid-term target of reducing greenhouse gas emissions by 26% from 2013 to 2030 at COP21. In Japan, CO_2 emissions from the transport sector account for 18.5% of total CO_2 emissions, and it is necessary to implement measures in the automobile sector as soon as possible. In this study, we developed a model for estimating CO_2 emissions that takes into account integrated measures in the automobile sector up to the year 2050. Global warming measures in the automobile sector to be considered in this model include the improvement of fuel efficiency of conventional vehicles, diffusion of next-generation vehicles, diffusion of automated driving (including eco-drive effects), improvement of traffic flow, and diffusion of car sharing. Using the developed model, and assuming several scenarios studied by the authors, the effects of technological progress in automobiles and the effects of measures that may be introduced in the future are considered.

(3) Measurement report: Source Characteristics of Water-soluble Organic Carbon in PM2.5 at Two Sites in Japan, as Assessed by Long-term Observation and Stable Carbon Isotope Ratio

Nana Suto (JARI), Hiroto Kawashima (Akita Prefectural Univ.)

Atmospheric Chemistry and Physics, Vol.21 (15), 2021 年 8 月
https://doi.org/10.5194/acp-21-11815-2021

The sources and seasonal trends of water-soluble organic carbon (WSOC) in carbonaceous aerosols are of significant interest. From July 2017 to July 2019, we collected samples of $PM_{2.5}$ (particulate matter, aerodynamic diameter < 2.5 µm) from one suburban and one rural site in Japan. The average $\delta^{13}C_{WSOC}$ was −25.2 ± 1.1‰ and −24.6 ± 2.4‰ at the suburban site and rural site, respectively. At the suburban site, the $\delta^{13}C_{WSOC}$ was consistent with the $\delta^{13}C$ of levoglucosan, a tracer of biomass burning, and a high correlation was found between WSOC concentration and non-sea-salt potassium concentration, another tracer of biomass burning, suggesting that the main source of WSOC was biomass from burning of rice straw. At the rural site, the $\delta^{13}C_{WSOC}$ was

significantly heavier in winter (−22.6 ± 1.3‰) than in summer (−27.4 ± 0.7‰; $p < 0.01$). The heavy $\delta^{13}C_{WSOC}$ in winter was a result mainly of biomass burning and the aging of OC during long-term transport, whereas the light $\delta^{13}C_{WSOC}$ in summer was a result mainly of the formation of secondary organic aerosols from biogenic volatile organic compounds. Thus, our $\delta^{13}C_{WSOC}$ approach was useful to elucidate the sources and atmospheric processes that contribute to seasonal variations of WSOC concentrations.

(4) 30 Years of Air Quality Trends in Japan

Akiyoshi Ito (JARI), Shinji Wakamatu (Ehime Univ.),
Tazuko Morikawa (JARI), Shinji Kobayashi (NIES)
Atmosphere, Vol.12, No.8, Special Issue "Air Pollution in Japan", 2021 年 8 月
https://doi.org/10.3390/atmos12081072

The aim of this paper is to obtain information that will contribute to measures and research needed to further improve the air quality in Japan. The trends and characteristics of air pollutant concentrations, especially $PM_{2.5}$, ozone, and related substances, over the past 30 years, are analyzed, and the relationships between concentrations and emissions are discussed quantitatively. We found that $PM_{2.5}$ mass concentrations have decreased, with the largest reduction in elemental carbon (EC) as the $PM_{2.5}$ component. The concentrations of organic carbon (OC) have not changed significantly compared to other components, suggesting that especially VOC emissions as precursors need to be reduced. In addition, the analysis of the differences in $PM_{2.5}$ concentrations between the ambient and the roadside showed that further research on non-exhaust particles is needed. For NOx and SO_2, there is a linear relationship between domestic anthropogenic emissions and atmospheric concentrations, indicating that emission control measures are directly effective in the reduction in concentrations. Also, recent air pollution episodes and the effect of reduced economic activity, as a consequence of COVID-19, on air pollution concentrations are summarized.

＜安全分野＞

(5) 自動車運転者の運転技量差に着目した交差点場面における自転車との潜在的な衝突リスクの分析

面田 雄一, 岩城 亮, 安部 原也 (JARI), 小川伯文 (自工会)
自動車技術会論文集, Vol.52, No.3, 2021 年 5 月
https://doi.org/10.11351/jsaeronbun.52.601

This study focuses on the high-risk scene for bicyclist accidents wherein vehcile drivers pass through intersections. In particular, this study focuses on the situations where a Bicycle potentially crosses. The behaviors of drivers with different driving skill, including expert, young-aged, middle-aged, and senior drivers, were examined on the test course. The driving indices of potential collision risk to a bicyclist suddenly crosses were examined. Based on our analyses, we clarified that expert drivers operated the vehicle at lower speeds than young and senior drivers. Furthermore, it is necessary to support the pedal operation in addition to speed limit in specific driving situations depending on driving skill.

(6) 潜在的な事故危険場面通過時の走行速度適正化に向けた視覚情報提供の効果評価

山口 伊織, 北島 創, 安部 原也, 中村 弘毅 (JARI)
自動車技術会論文集, Vol.52, No.3, 2021 年 5 月
https://doi.org/10.11351/jsaeronbun.52.608

Drivers does not always make sufficient deceleration for accident prevention when they pass through potentially danger situation, such as a road with blind spot where a pedestrian may rush into the road. In this study, we set up a system that assists a driver with visual information for appropriate driving speed adjustment through potentially danger situation, and evaluated its effect through a test track experiment using an augmented reality vehicle.

(7)　交通安全対策を念頭に置いたマレーシアの交通実態把握(第 2 報)
　　―四輪車直進走行時の前方二輪車挙動の分析―

川越 麻生, 今長 久 (JARI), 榎田 修一 (九州工業大),
Azhar Bin Hamzah (MIROS), 石田 肇 (自工会)
自動車技術会論文集,　Vol.52, No.3,　2021 年 5 月
https://doi.org/10.11351/jsaeronbun.52.707

The purpose of this study is to quantitatively understand the actual traffic situation between vehicle and motorcycle which is useful for preventing motorcycle accidents. From the video data recorded in Malaysia, we analyzed the behavior of motorcycles such as minimum distance between vehicles and minimum lane position in situations which can lead to rear-end collisions and head-on collisions which the number of vehicle-to-motorcycle fatal accidents in Malaysia is high. These results could help in the development of safety equipment to prevent motorcycle accidents.

(8)　運転行動に影響する車内音声タスクの要因に関する実験調査

宇野 宏 (JARI), 古賀光, 佐藤真平, 阿部正明 (自工会)
自動車技術会論文集,　Vol.52, No.4,　2021 年 7 月
https://doi.org/10.11351/jsaeronbun.52.800

Four kinds of experiments were carried out using a driving simulator to extract factors degrading the driver's behavior while performing in-vehicle voice control tasks. The following characteristics of voice control tasks increase fluctuations of vehicle lateral position and headway: (1) speech recognition system error in contrast with a relatively small response delay impact, (2) combined use of visual display presenting much information, (3) long task duration, and (4) task demands on the driver for remembrance and/or calculation. Moreover, the headway fluctuation was more sensitive to the aforementioned influences than the vehicle lateral fluctuation. The results revealing the possible elements that impede the driver's behavior would help further improve voice control tasks by eliminating these from the tasks.

(9)　歩行中の子どもによる手つなぎ拒否と保護者の愛着・養育態度との関係

大谷 亮 (JARI)
応用心理学研究, Vol.47, No.2,　2021 年 11 月
https://doi.org/10.24651/oushinken.47.2_94

Children's refusal to hold hands (RHH) with their parents on the road may increase the risk of road accidents. We examined the relationship between children's RHH and factors, such as parental tendency of attachment and caregiving, and gender and age of them and their children. A total of 663 parents completed a questionnaire about their children's RHH in two dangerous and two safe situations, assuming they were walking with their youngest children aged between 3 to 10 years. Parents were also instructed to answer the attachment-caregiving balance scale. The gender and age of both parents and their children were recorded. The results of logistic regression analysis showed that the parental tendency of attachment was associated with their children' s RHH in both dangerous and safe road situations. In addition, children's RHH in a safe road situation was influenced by the parental tendency of caregiving and the children's genders. The findings suggest that proper parent's tendency of attachment and caregiving were important for reducing road accidents involving children and promoting their independence.

(10)　緊急場面におけるドライバの回避操作に関する研究
　　―オーバーラップ率が大きい場合の回避操作―

鈴木 崇, 若杉 貴志, 菊地 一範 (JARI), 千賀 雅明, 味村 寛, 占部 博之, 平田 直 (自工会)

自動車技術会論文集，Vol.53, No.1，2022 年 1 月
https://doi.org/10.11351/jsaeronbun.53.71

While there is an increasing societal need to reduce traffic accidents, understanding the characteristics and tendencies of drivers' actions in a traffic accident is crucial, not only for automobile development, but also for discussions into the formulation of standards for ADAS(Advanced Driver-Assistance Systems). Therefore, a driving simulator has been used to understand the characteristics of drivers' actions by different age groups (elderly, middle-aged, and young), when faced with scenes requiring emergency avoidance. As a result, it was found that many drivers avoid by steering at high speeds, and in emergency avoidance, the avoidance direction is on the driver's side. ESF (Emergency Steering Function) operation timing has also been proposed.

(11) 一般年齢層のドライバを対象としたペダル踏み間違いに至る操作過程の分析

細川 崇, 橋本 博 (JARI), 平松 真知子, 石田 肇 (自工会)
自動車技術会論文集，Vol.53, No.2，2022 年 3 月
https://doi.org/10.11351/jsaeronbun.53.264

This study focused on pedal misapplication accidents which have become a social problem. A driving simulator was used to reproduce the situation in which missteps are likely to occur, which was extracted from Japan Traffic Accidents In-Depth Database. We analyzed the pedal operation when the vehicle was stopped and when it was restarted. The stepping method that inverts the ankle joint requires less movement than the stepping method that moves the entire leg, making it easier to step on the accelerator side when braking. In startled situations, pedal depression speed was shown to increase, which could lead to unintended acceleration.

(12) 高齢者の視認行動および認知支援による効果分析
−出会い頭交差点における対自転車事故防止に向けた検討−

中村 弘毅, 安部 原也 (JARI), 小川 伯文 (マツダ)
自動車技術会論文集，Vol.53, No.2，2022 年 3 月
https://doi.org/10.11351/jsaeronbun.53.424

The reduction of accidents caused by elderly drivers is priority subject to achieve safe traffic. Specifically, car to bike accidents at crossing with bad visibility have been occurred frequently. To reduce such accidents caused by elderly drivers, this study fucus on the visual behavior analysis of elderly drivers observed through driving simulator experiment. Also, several driving assistant systems are installed and improvement of visual cognition level is evaluated. As a result, distinctive visual features of elderly drivers are examined by comparing with those of expert drivers. Further, suitable features of driving assistance for elderly drivers are discussed.

(13) Data Augmentation を用いた深層学習手法による歩行者衝突検知システムの検出率改善

國富 将平, 鮭川 佳弘 (JARI), 白川 正幸 (自工会)
自動車技術会論文集，Vol.53, No.2，2022 年 3 月
https://doi.org/10.11351/jsaeronbun.53.391

We previously performed pedestrian collision detection using a deep learning method based on dashcam video data. However, the detection accuracy was poor owing to insufficient training data. Herein, we attempted to improve the accuracy of the detection for Advanced Automatic Crash Notification System (AACN) using data augmentation, which increases the amount of data by adding artificially generated training data. As a result of comparing the effects of multiple image

processing methods on the detection rate, the detection rate increased to 86.85% by adding training data with reduced contrast. This rate was 34.37 points higher than the conventional rate.

(14) Application of Deep Learning Methods for Pedestrian Collision Detection using Dashcam Videos

Shouhei Kunitomi, Shinichi Takayama (JARI), Masayuki Shirakawa (JAMA)
Stapp Car Crash Journal, Vol. 64, 2021 年 4 月
https://doi.org/10.4271/2020-22-0008

The goal of this study is to clarify the usefulness of deep learning method for pedestrian collision detection using dashcam videos for Advanced Automatic Collision Notification (AACN), focusing on the pedestrian with the highest number of traffic fatalities in japan. First, we created a dataset for deep learning from dashcam videos. Dashcam videos of pedestrian-to-automobile accident ware collected from video sharing websites, and 78 video data were obtained together with the data owned. These videos ware converted to 1210 images, and then added with class and location information. Next, deep learning was performed based on the training dataset to learn the feature of pedestrian collision images. Finally, we evaluated the accuracy of pedestrian collision detection for the trained model using the Average Precision and test dataset. In the pedestrian collision detection, high-precision collision detection by the proposed method was observed for daytime clear pedestrian crossing accident data. The location information of pedestrian collision can also be detected accurately. On the other hand, false or no detection of pedestrian collisions has occurred for nighttime unclear accident data. Furthermore, the comparison results of the changing the exposure value and resolution, it was confirmed indicate that the detection accuracy deteriorated due to the reduction of these factors. The present result suggested that the possibility of high-precision pedestrian collision detection by deep learning using dashcam videos. In addition, the correlation of the brightness and clarity of the prediction target image with the detection accuracy became clear.

(15) The Effect of Searback Inclination on Spinal Alignment in Automotive Seated Postures

Fusako Sato (JARI), Yusuke Miyazawa (Tokyo Institute of Technology),
Shigehiro Morikawa (Shiga Univ. of Medical Science),
Antonio Ferreiro Perez (Fundacione de Investigacion HM Hospitales),
Sylvi Schick (Ludwig-Maximilians-Univ. of Munich),
Karin Brolin (Chalmers Univ.), Mats Svensson (Chalmers Univ.)
Front. Bioeng. Biotechnol. Vol.2, 2021 年 8 月
https://doi.org/10.3389/fbioe.2021.684043

Experimental studies have demonstrated a relationship between spinal injury severity and vertebral kinematics, influenced by the initial spinal alignment of automotive occupants. Spinal alignment has been considered one of the possible causes of gender differences in the risk of sustaining spinal injuries. To predict vertebral kinematics and investigate spinal injury mechanisms, including gender-related mechanisms, under different seat back inclinations, it is needed to investigate the effect of the seat back inclination on initial spinal alignment in automotive seating postures for both men and women. The purpose of this study was to investigate the effect of the seat back inclination on spinal alignments, comparing spinal alignments of automotive seating postures in the 20◦ and 25◦ seat back angle and standing and supine postures. The spinal columns of 11 female and 12 male volunteers in automotive seating, standing, and supine postures were scanned in an upright open magnetic resonance imaging system. Patterns of their spinal alignments were analyzed using Multidimensional Scaling presented in a distribution map. Spinal segmental angles (cervical curvature, T1 slope, total thoracic kyphosis, upper thoracic kyphosis, lower thoracic kyphosis, lumbar lordosis, and sacral slope) were also measured using the imaging data. In the maximum individual variances in spinal alignment, a relationship between the cervical and thoracic spinal alignment was found in multidimensional scaling analyses.

Subjects with a more lordotic cervical spine had a pronounced kyphotic thoracic spine, whereas subjects with a straighter to kyphotic cervical spine had a less kyphotic thoracic spine. When categorizing spinal alignments into two groups based on the spinal segmental angle of cervical curvature, spinal alignments with a lordotic cervical spine showed significantly greater absolute average values of T1 slope, total thoracic kyphosis, and lower thoracic kyphosis for both the 20◦ and 25◦ seat back angles. For automotive seating postures, the gender difference in spinal alignment was almost straight cervical and less-kyphotic thoracic spine for the female subjects and lordotic cervical and more pronounced kyphotic thoracic spine for the male subjects. The most prominent influence of seatback inclination appeared in Total thoracic kyphosis, with increased angles for 25◦ seat back, 8.0◦ greater in spinal alignments with a lordotic cervical spine, 3.2◦ greater in spinal alignments with a kyphotic cervical spine. The difference in total thoracic kyphosis between the two seatback angles and between the seating posture with the 20◦ seat back angle and the standing posture was greater for spinal alignments with a lordotic cervical spine than for spinal alignments with a kyphotic cervical spine. The female subjects in this study had a tendency toward the kyphotic cervical spine. Some of the differences between average gender-specific spinal alignments may be explained by the findings observed in the differences between spinal alignments with a lordotic and kyphotic cervical spine.

(16) Effects of Gender, Age, Experience, and Practice on Driver Reaction and Acceptance of Traffic Jam Chauffeur Systems

Husam Alzamili (JARI), Makoto Itoh, Cho Kiu Liang (Univ. of Tsukuba), Jacobo Antona-Makoshi, Nobuyuki Uchida (JARI)
Scientific Reports, Vol.11, No.1, 2021 年 9 月
https://doi.org/10.1038/s41598-021-97374-5

This study conducted a driving simulation experiment to compare four automated driving systems (ADS) designs during lane change demanding traffic situations on highways while accounting for the drivers' gender, age, experience, and practice. A lane-change maneuver was required when the automated vehicle approaches traffic congestion on the left-hand lane. ADS-1 can only reduce the speed to synchronize with the congestion. ADS-2 reduces the speed and issues an optional request to intervene, advising the driver to change lanes manually. ADS-3 offers to overtake the congestion autonomously if the driver approves it. ADS-4 overtakes the congestion autonomously without the driver's approval. Results of drivers' reaction, acceptance, and trust indicated that differences between ADS designs increase when considering the combined effect of drivers' demographic factors more than the individual effect of each factor. However, the more ADS seems to have driver-like capacities, the more impact of demographic factors is expected. While preliminary, these findings may help us understand how ADS users' behavior can differ based on the interaction between human demographic factors and system design.

(17) Defining Reasonably Foreseeable Parameter Ranges Using Real-World Traffic Data for Scenario-Based Safety Assessment of Automated Vehicles .....

Hiroki Nakamura, Husamu Muslim, Ryousuke Kato, Sandora Prefontaine-Watanabe, Hideo Nakamura, Hitoshi Kaneko, Hishashi Imanaga, Jacobo Antona-Makoshi, So Kitajima, Nobuyuki Uchida (JARI), Eiichi Kitamura, Koichiro Ozawa, Satoshi. Taniguchi (JAMA)
IEEE Access, Vol.10, 2022 年 3 月
https://doi.org/10.1109/ACCESS.2022.3162601

Veri_cation and validation of automated driving systems' safety are some of the biggest challenges for the introduction of automated vehicles into the market. Scenario-based safety assessment is an ef_cient and repeatable method to test the systems' safety before their deployment in the real world. However, even with limited traf_c situations identi_ed as critical to the system behavior, there is still an open range of parameters to describe each situation. Thus, de_ning speci_c

parameter ranges is crucial to realize the scenario-based safety assessment approach. This study proposes a method to parameterize scenarios extracted from real-world traf_c data, analyze their distribution and correlation, and incorporate them into the de_nition of reasonably foreseeable parameter ranges through the contextualization of resulting ranges with reasonable risk acceptance thresholds from different _elds and international environments. Representative values can be selected from these speci_c parameter ranges to extract speci_c concrete scenarios applicable for the systems safety assessment. The applicability of the proposed method is demonstrated using parameter ranges obtained to de_ne two sets of 960 cut-in and 6,442 deceleration scenarios extracted from a new set of traf_c data collected from Japanese highways under the SAKURA initiative. The outcomes will enable comparisons with traf_c data from other countries and inform automated driving system developers, standardization bodies, and policymakers to develop automated vehicle safety assessments applicable internationally.

(18) Effect of Pedestrian Physique Differences on Head Injury Prediction in Car-to-pedestrian Accidents Using Deep Learning

Shouhei Kunitomi, Shinichi Takayama (JARI)
Traffic Injury Prevention, Vol.22, 2021 年 4 月
https://doi.org/10.1080/15389588.2021.1981886

Objective: The aim of this study is to identify the effects of pedestrian physique differences on head injury prediction in car-to-pedestrian incidents via deep learning.

Methods: A series of parametric studies was carried out using a family car finite element model and MADYMO pedestrian models (AM50, AF05, 6YO). The car model was developed and validated by 12 impact tests. The initial gaits for the pedestrian models were obtained from volunteer experiments to reproduce 420 pre-crash reactions. Furthermore, by factoring the pedestrian models (3 types), pedestrian directions (2 each), impact positions (3 each), and car velocities (6 levels) with the pre-crash parameters, a total of 45,360 car-to-pedestrian impact simulations were performed. After simulation, image datasets were created by labeling the pedestrian collision images with head injury criteria (HIC) and dividing the images into training and test data based on model type. Next, deep learning was conducted using the training dataset to obtain trained models. Finally, the effects of pedestrian physique differences on head injury predictions were investigated via the accuracy of each trained model for test data.

Results: Using the developed and validated car model, 45,360 impact simulations were conducted, comprehensively reproducing real-world car-to-pedestrian accidents. From the results, it is clear that the head impact area and the amount of pedestrian information in the image differ depending on the pedestrian models. In head injury prediction with deep learning, AF05 showed the highest prediction accuracy (93.25%), followed by AM50 (90.61%) and 6YO (88.29%). These results show the high performance of deep-learning methods in head injury predictions for not only adult men but also children and small women. Furthermore, our results demonstrate that pedestrian physique differences affect injury prediction accuracies.

Conclusions: Based on the prediction results of trained models that have learned the relationships between pedestrian collision images and HIC from simulations, we show that pedestrian physique differences affect the head injury prediction accuracies using deep learning. Furthermore, we concluded that this effect may have been caused by differences in head contact area and the amount of pedestrian information between the models.

2021年度
JARI 研究論文集

発行日：2022年8月31日
発行所：一般財団法人 日本自動車研究所
〒305-0822 茨城県つくば市苅間2530
URL：http://www.jari.or.jp

印刷所：

編集事務担当：
一般財団法人 日本自動車研究所
企画・管理部広報グループ
TEL　：029-856-1128
FAX　：029-856-1124
E-mail：sogomado@jari.or.jp

一般財団法人 日本自動車研究所