LIGHTWEIGHT ELECTRIC

POWER

TWO WHEELERS IN

EARLY DEVELOPMENT STAGE



4a Technology Day 2020

Wazel Benjamin Werfenweng, 03.03.2020



Plastics on the test rig - Testing and simulation

KTM TECHNOLOGIES

Part of the Pierer Mobility AG

Location: Anif, nearby Salzburg 120 employees in:

- CAE CFD, Crash, TopoOpt (20 employees)
- Mechanical Design
- Electric Engineering
- Composite Manufacturing Technology Kiska as design-partner next door



KTM Technologies GmbH

e-mobility projects in the past

Two-, Three- and Four-Wheelers







Intro

FOCUS OF THE PRESENTATION

Only on ...

- ... topics related to Crash Simulation
- ... topics related to Impetus/Valimat



Intro

AGENDA

- _ Intro
- _ Standard two-wheeler crash scenario
- _ Recent electr. two-wheeler scenarios
 - _ Battery drop test
 - _ Full vehicle
- _ Outlook



ler crash scenario wheeler scenarios

AGENDA

Introduction

Standard Scenario

Recent electr. two-wheeler scenarios

Outlook

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TANK CRASH SCENARIO

Pre-serial Concept Simulations

450 J impactor energy on relevant locations IMPETUS/VALIMAT for material card creation

Challenges

Safety relevant part

According to SAE J1241 the test is at -20 °C

Manufacturing process

Failure starts not always at impact location





Testbench model example

Many different design iterations for every new two-wheeler concept







Present Crash Secenario

AGENDA

Introduction

Tank Crash Scenario

Recent e-two-wheeler scenarios

Outlook



PORTABLE BATTERY PACKS

m





DROP TEST SIMULATION

For portable batteries

Relevant test according to ECE R100

- Ground drop during transport to the charching station results; 1 m drop height
- _ Different pack orientations are tested
- Material card creation via IMPETUS/VALIMAT process for plastics

Challenges

Very small features to capture





Recent e-two-wheeler scenarios

BATTERY MODELLING

Present battery material modelling with mat_142 transversly_isotropic_crushable_foam

Tests done by the VSI Graz

Sufficient agreement in case of concept phase considerations

Improving the dynamical response under investigation



Force – Displacement in lateral direction



Force – Displacement in longitudinal direction



Recent e-two-wheeler scenarios





displacement

INTERNAL BATTERY PACK DESIGN

Challenges

Limited space in two-wheelers Heat management to prevent local overheating Crash behavior

Additive Manufacturing

Fast creation of different design solutions Complex concept structures possible



KTM-T AM Labor with EOS P396



AM Battery holder



Recent e-two-wheeler scenarios



Internal crash behavior of portable battery packs

front impact



lateral impact





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Recent e-two-wheeler scenarios

FULL VEHICLE





FULL VEHICLE CRASH

Definition of relevant crash scenarios

e.g. ADAC:

- _ Slipping away from the street
- _ Hitting a car turning into the street
- _ Hitting a car which breaks appruptly

Cooperations

VSI – Vehicle Safty Institute in Graz



Statistisches Bundesamt Wiesbaden, Verkehrsunfälle 2013, Juli 2014, Artikelnummer: 2080700137004



Simulation models

Recent e-two-wheeler scenarios

nstitut für Fahrzeugsicherheit

WISSEN TECHNIK LEIDENSCHAFT

PLOLE SLIDING IMPACT

Goal

Minimizing the risk of thermal run-away in case of Li-Ion battery packs

Challenges

Battery is fully involved in the crash Few possibilities for energy absorbing elements

Example at 30 km/h and 47° impact angle Simplified driver modelling







Recent e-two-wheeler scenarios



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FRONTAL IMPACT

Investigation of multiple impact scenarios

- _ Worst case rigid wall
- _ Car impact
- Check of intrusions/ accelerations











Recent e-two-wheeler scenarios

AGENDA

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FUTURE STEPS

Material modelling improvements

Battery material model Short fiber reinforced plastics

Multidiscipline simulation

Improving e.g. thermo-electrical simulation issus

- heat distribution
- heat reansfer coefficient
- _ 1-D electric circuit models



Heat flow losses



Outlook



DRIVEN BY THE NEW

