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**competition  
about designing  
and building a  
single-seater  
racing car. One  
of the most  
important parts  
in a car is the  
suspension  
system, from  
the tires to the  
shock**

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**absorbers. This  
Master Thesis'  
report goes  
through all  
these parts,  
looking to  
theory, different  
design options,  
the constraints  
(rules,  
economical,  
packaging, etc)**

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***and the final  
decisions and  
designs. All  
motivated  
within the  
suspension area  
in LURacing  
Team, for  
designing and  
building the  
LUR3, the third  
Formula***

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***Student car of  
LTH-Lund  
University. The  
initial idea was  
to design a  
completely new  
suspension for  
the new 2009  
car, but for  
timing and  
economical  
reasons it has***

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***been only a  
redesign of the  
existing  
suspension  
system. But as  
it will be shown,  
new rules and  
frame will affect  
considerably the  
design and most  
of the parts may  
be redesigned.***

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***This invaluable  
handbook on  
the structural  
design and  
science behind  
the race car  
chassis includes  
sections on  
materials and  
structures,  
structural loads,  
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**of suspension  
and chassis**

**design, multi-  
tube and space  
frame chassis,  
joining ferrous  
metals, stressed  
skin  
construction,  
and joining light  
alloys.**

**Discusses the**



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***design and  
development of  
shock absorbers  
with emphasis  
on applications  
to a Formula  
SAE race car.  
The car's  
combination of  
very low vehicle  
mass and large  
suspension***

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***stroke limits the  
number of  
appropriate off  
the shelf  
damper  
solutions. To  
address this  
issue, the 2006  
University of  
Michigan  
Formula SAE  
team designed***

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***and developed a custom set of dampers. The team focused on the damper's function in the vehicle and how certain damper performance characteristics affect dynamic response.***

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***Design,  
Construction,  
Tuning  
Proceedings of  
the FISITA 2012  
World  
Automotive  
Congress  
The Design of  
an Innovative  
Automotive  
Suspension for***

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**Formula SAE  
Racing**

**Applications**

**Formula SAE Car  
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**Design and  
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**Race Car Design**

*This book presents the  
select proceedings of the  
second International  
Conference on Recent*

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Advances in Mechanical  
Engineering (RAME*

*2020). The topics*

*covered include*

*aerodynamics and fluid*

*mechanics, automation,*

*automotive engineering,*

*composites, ceramics*

*and polymers*

*processing,*

*computational*

*mechanics, failure and*

*fracture mechanics,*

*friction, tribology and*

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*surface engineering,  
heating and ventilation,  
air conditioning system,  
industrial engineering,  
IC engines,  
turbomachinery and  
alternative fuels,  
machinability and  
formability of materials,  
mechanisms and  
machines, metrology  
and computer-aided  
inspection, micro- and  
nano-mechanics,*

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and optimization,*

*product design and  
development, rapid  
manufacturing*

*technologies and  
prototyping, solid  
mechanics and*

*structural mechanics,  
thermodynamics and  
heat transfer, traditional  
and non-traditional  
machining processes,  
vibration and acoustics.*



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*This paper will explore the features that optimize suspension performance for a Formula SAE racecar, focusing on suspension geometry. Employing research and designs from previous year's cars, the suspension will be designed using the*

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*iterative design process.*

*To help with this process, multiple programs and methods will be used. When the design is finalized it will be built and installed on the 2019 Viking Motorsport's Formula SAE car.*

*This book attempts to find a middle ground by balancing engineering principles and equations*

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*of use to every  
automotive engineer  
with practical  
explanations of the  
mechanics involved, so  
that those without a  
formal engineering  
degree can still  
comprehend and use  
most of the principles  
discussed. Either as an  
introductory text or a  
practical professional  
overview, this book is an*

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*ideal reference.*

*Formula SAE Frame  
and Suspension Design  
Redesign of a  
Suspension for a FSAE  
Car*

*Design of a Carbon  
Fiber Suspension  
System for FSAE  
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*Formula SAE Front  
Suspension System*

Design of Formula  
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Suspension Formul  
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Design Formula  
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Suspension Design  
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Congress, which is held by Society of Automotive Engineers of China (SAE-China ) and the International Federation of Automotive Engineering Societies (FISITA). This proceedings focus on solutions



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Vehicle Above all researchers, professional engineers and graduates in fields of automotive engineering, mechanical engineering and electronic engineering will benefit from this

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book. SAE-China is a national academic organization composed of enterprises and professionals who focus on research, design and education in the fields of automotive and related

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industries. FISITA is the umbrella organization for the national automotive societies in 37 countries around the world. It was founded in Paris in 1948 with the purpose of bringing engineers from around the world

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together in a spirit  
of cooperation to  
share ideas and  
advance the  
technological  
development of the  
automobile.

This thesis details  
an analytical  
approach to an  
innovative  
suspension system

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design for implementation to the Formula SAE collegiate competition. It focuses specifically on design relating to geometry, mathematical modeling, energy element relationships, and

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computer analysis and simulation to visualize system behavior. The bond graph approach is utilized for a quarter car model to facilitate understanding of the analytical process, then applied to a



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comparative  
analysis between  
two transverse half  
car models. The  
second half car  
model contains an  
additional  
transverse linkage  
with a third  
damper, and is  
compared against  
the baseline of the

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first half car model without the additional linkage. The transverse third damper is an innovative design said to improve straight-line tire contact during single-sided disturbance, help mitigate the

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adverse effects of squat and dive, while not inhibiting the function of the anti-roll bar in cornering capability.

Additional work is done investigating an optimization of suspension geometry through

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mathematical

modeling in

MATLAB of a four-  
bar linkage system.

This code helps  
visualize the

complex motion of  
the upright and

calculates the

wheel camber rate  
and variation to

compare against

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tire data analysis to match maximum tire performance characteristics with camber angle.

The Design & Fabrication of the Formula SAE Chassis and Suspension  
Design of suspension for

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Chassis

Engineering  
Design and  
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China. Featuring  
contributions

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mainly from  
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biggest carmaker  
as well as most  
dynamic car  
market in the  
world, the book  
covers a wide  
range of automot  
ive-related  
topics and the  
latest technical  
advances in the  
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of the approaches in the book will help technicians to solve practical problems that affect their daily work. In addition, the book offers valuable technical support to

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engineers,  
researchers and  
postgraduate  
students in the  
field of  
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suspension  
geometry design  
methods in  
unique detail,  
John Dixon shows  
how suspension

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properties such as bump steer, roll steer, bump camber, compliance steer and roll centres are analysed and controlled by the professional engineer. He emphasizes the physical understanding of suspension

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qualitative  
explanation, for  
physical  
understanding,  
with algebraic  
analysis of  
linear and non-  
linear  
coefficients,  
and detailed  
discussion of  
computer  
simulations and  
related

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design, fully  
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a wealth of  
diagrams  
Explains  
suspension

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and suspension

geometry

coefficients,

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understanding of  
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design not found  
elsewhere.

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obtain desired  
coefficients and

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the limitations  
of particular  
suspension  
types, with  
essential  
information for  
suspension  
designers,  
chassis  
technicians and  
anyone else with  
an interest in  
suspension  
characteristics



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have developed  
many of the  
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covered in this  
book, including  
the Moment  
Method, "g-g"  
Diagram, pair

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level. It  
explains  
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dynamics  
concepts in  
detail,

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rear, and four  
wheel steering  
systems, as  
well as the  
advantages and  
disadvantages  
of different  
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emphasis on  
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throughout the  
text, which  
provides a  
practical,  
hands-on  
approach

The suspension  
geometry is  
the foundation  
of a  
performance  
vehicle's

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design because  
it dictates  
the overall  
packaging  
constraints  
and the  
connection  
between the  
chassis and  
the tires.  
This thesis  
details the

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design process  
used to  
produce the  
suspension  
geometry for  
MIT  
Motorsports'  
2018 Formula  
SAE car and  
the  
justification  
for each

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design  
decision made.  
A thorough  
iteration  
process was  
used to  
prevent  
compromises  
that could  
significantly  
detract from  
specific

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component  
performance in  
order to meet  
suspension  
kinematic  
requirements.  
Using this  
process, the  
kinematic  
performance of  
the suspension  
was maximized

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by minimizing  
the roll  
center's  
movement and  
designing the  
tire camber  
change charact  
eristics to  
achieve  $0^\circ$  of  
outer-wheel  
camber while  
at the car's



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maximum

lateral

acceleration.

Reducing

weight while

maintaining

structural

integrity is

one of the key

challenges

Formula SAE

teams face as

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they try and design the suspension of the formula car. The purpose of this paper is to present experimental data on designing and optimizing a

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carbon fiber  
suspension  
system for  
formula cars.  
The reason  
carbon fiber  
suspensions  
are favored  
over the  
current steel  
suspensions is  
because of

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they can  
reduce the  
weight of the  
suspension by  
50%. Pull  
tests on an  
Instron  
machine were  
performed on  
over 15  
specimens  
composed of a

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carbon fiber  
tube with an  
aluminum  
insert bonded  
to each end.  
Loctite  
E-120HP epoxy  
was used and  
the surface  
preparation,  
bond gap, and  
bond length

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were varied to find the optimal bond strength. An average bond strength of 2,382.6 pounds per square inch was determined for specimens with surface

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preparation.

Furthermore a bond gap of 0.0065 to 0.008 inches was found to give the strongest bond.

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Members

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Whole-vehicle

Suspension  
Dynamic

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Racing Car

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Electric Car

Designing and

constructing a chassis

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and suspension system for a Formula SAE racecar is a highly complex task involving the interaction of hundreds of parts that all perform an essential function. This thesis examines the critical factors in designing and implementing a Formula SAE chassis from the ground up, with a focus on the

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performance and optimization of the vehicle as an entire system rather than a collection of individual parts. Analysis includes examining the stiffness, strength, and weight of each part, as well as design verification. The thesis will serve as a summary of the knowledge that I have accumulated over four

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years of personally designing and overseeing the manufacturing of the MIT Motorsports suspension, provide insight into the design of the MY2009 vehicle, and act as a guide for future chassis designers. Through appendices and diagrams, Car Suspension and Handling, Fourth

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Edition, outlines the purpose and history of vehicle suspension systems, while defining the basic parameters of suspension geometry. In addition, the book delves into human sensitivity to vibration and offers data on durability, tyre background information, steering calculations and

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suspension calculations.

While always recognizing that there are differences in suspension requirements for different classes of vehicles and in various markets of the world for a given vehicle, this book focuses on the suspension and handling of cars or automobiles, as opposed to those characteristics

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of other types of road vehicles. Engineers in the automotive industry who are involved with handling analysis and design, students seeking more thorough understanding of the fundamental concepts and potential problem areas, and university/college libraries.

The objective of this

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project is the study, calculations and design of the Formula Student ETR-04 single-seater suspension system. The ETR-04 is the fourth electric racing vehicle designed and built by the e-Tech Racing team from the Barcelona East School of Engineering and is the vehicle for which the suspension system described in this



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paperhas been designed and studied in this project. This car participated in the ninth edition (2018) of the Formula Student Spain (FSS). The Formula Student is an international competition in which several world universities design and manufacture a competition single-

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seater which presents different independent events, but within the same regulatory rules; either electric or combustion. To get the best possible score designs have to be made to optimize performance in all the tests in which each vehicle is scored. Single-seaters are redesigned to compete in Formula

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Students are evaluated in two test modes, static (in which each team is evaluated by the design of its vehicle, the ability to attract investors to the project and the economic aspects of the execution of this design) and dynamic (in which the performance of the car in different tests is evaluated). Throughout this design process,

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special consideration has been given to all the tests in which the vehicle will be evaluated, as well as the optimization of the overall performance of the single-seater, with special consideration given to the balance between all the subsystems which are part of a vehicle with these characteristics.

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Suspension Design for  
SAE Formula Car

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Car Suspension and  
Handling

*In most forms of  
racing, cornering  
speed is the key to*

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*winning. On the street, precise and predictable handling is the key to high performance driving. However, the art and science of engineering a chassis can be difficult to comprehend, let alone apply. Chassis Engineering explains*

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of suspension*

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design in terms the  
novice can easily  
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Suspension  
cornering power on  
and off the track.*

*The suspension  
system of a FSAE  
(Formula Society of  
Automotive  
Engineers) vehicle is  
a vital system with  
many functions that  
include providing  
vertical compliance*



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*so the wheels can follow the uneven road, maintaining the wheels in the proper steer and camber attitudes to the road surface and reacting to the control forces produced by the tires (acceleration, braking and cornering). The members that*

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*comprise the suspension are subjected to a variety of dynamic loading conditions – it is imperative that they are designed properly to ensure the safety and performance of the vehicle. The goal of this research is to develop a model for*

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*predicting the  
reaction forces in the  
suspension members  
based on the expected  
load scenarios the  
vehicle will undergo.  
This model is  
compared to the  
current FSAE vehicle  
system and the design  
process is explained.  
The limitations of this*

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*Formula Sae  
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model are explored  
and future*

*methodologies and  
improvement  
techniques are  
discussed.*

*Based on the  
principles of  
engineering science,  
physics and  
mathematics, but  
assuming only an*

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*elementary understanding of these, this textbook masterfully explains the theory and practice of the subject. Bringing together key topics, including the chassis frame, suspension, steering, tyres, brakes, transmission,*

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*lubrication and fuel  
systems, this is the*

*first text to cover all  
the essential elements  
of race car design in  
one student-friendly  
textbook. It avoids the  
pitfalls of being  
either too theoretical  
and mathematical, or  
else resorting to  
approximations*

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*without explanation  
of the underlying*

*theory. Where  
relevant, emphasis is  
placed on the  
important role that  
computer tools play  
in the modern design  
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