Abstract

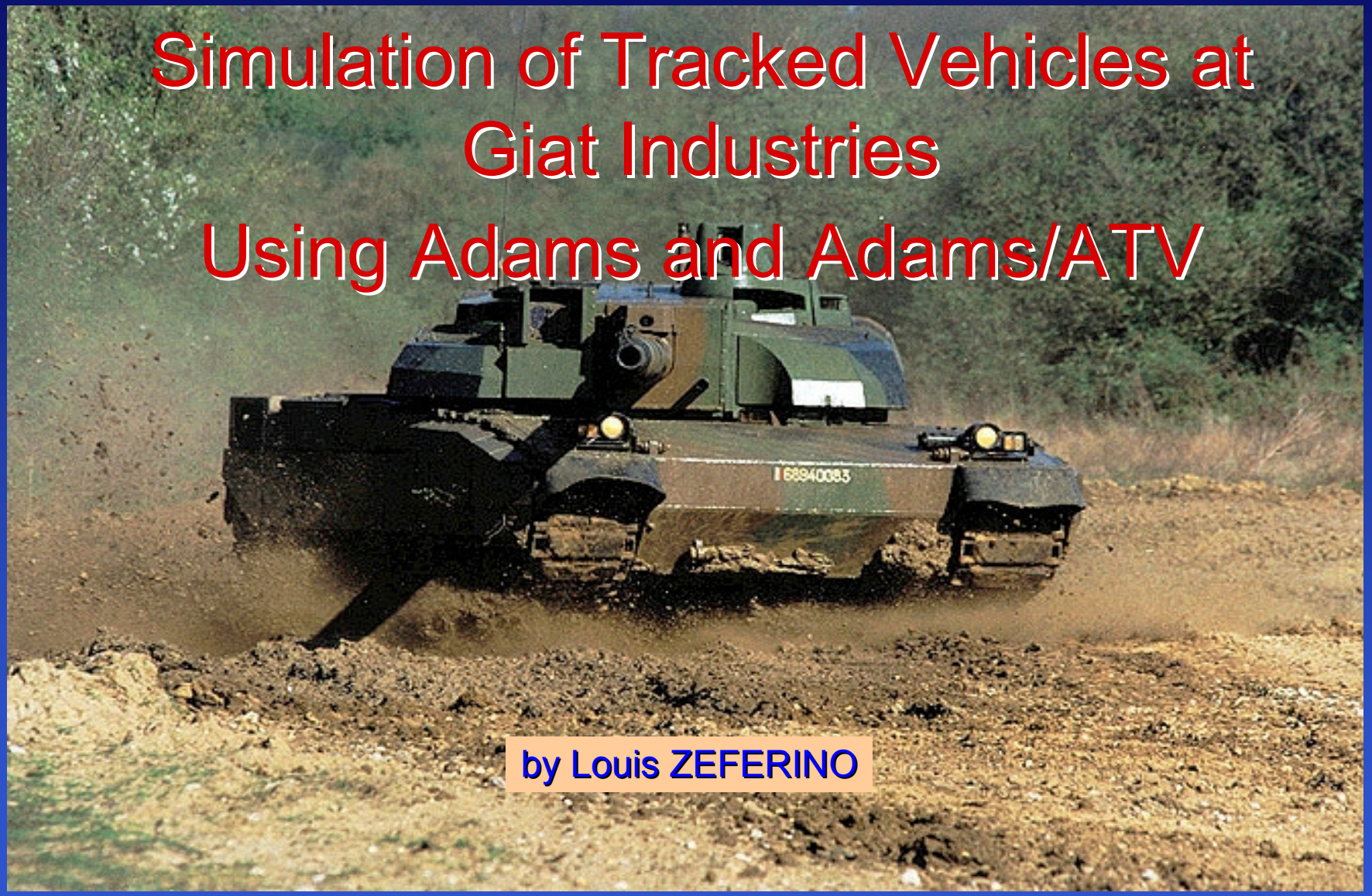
Simulation of Tracked Vehicles at Giat Industries

using Adams and ATV

In the field of tracked armored vehicles, requirements have become more and more acute in term of performances, cost and modularity.
The designers of tracked vehicles have been led to rely more and more on numerical simulations to predict or to ascertain the dynamic behavior of vehicles and to determine the levels of constraints engendered in the elements of the track system and on the hull.
As prime contractor of complete systems, Giat Industries have always based the products that they design or develop on control and quality.
That is why, already in the early 90's, Giat Industries started to use numerical simulations by creating their own models of tracked vehicles using ADAMS. Giat Industries have extended their effort by reinforcing the simulation means by acquiring ATV, the sub-module of ADAMS particularly dedicated to the modeling of tracked vehicles. This module allows for a specially fine description of the track.
This document presents some applications as regards the modelisation of tracked vehicles using ADAMS.

By Louis ZEFERINO

Simulation of Tracked Vehicles at Giat Industries Using Adams and Adams/ATV



by Louis ZEFERINO

Presentation Content

1 - Purpose/interest of the Numerical Simulation

2 - Numerical Simulation of Off-Road Vehicles using Adams software

3 - Numerical Simulation of Tracked Vehicles using Adams software

A numeric model of tracked vehicle to do what ?

- To foresee or to analyse averages and behaviour of our products
- To strengthen the certification of our products and performances
- To prepare new configurations of our vehicles
- To imagine tomorrow's vehicles

To foresee or to analyse averages and behaviour of our products

On various types of ground
In different configurations

To be able to determine :
shocks level,
the efforts range
the vibration influence On the tank equipment

To foresee or to analyse averages and behaviour of our products

On various types of ground In different configurations

To be able to determine :
shocks level, the efforts range
the vibration influence on
the tank equipment

To strengthen the certification of our products and performances

In term of behaviour of our tanks and reliability of our products

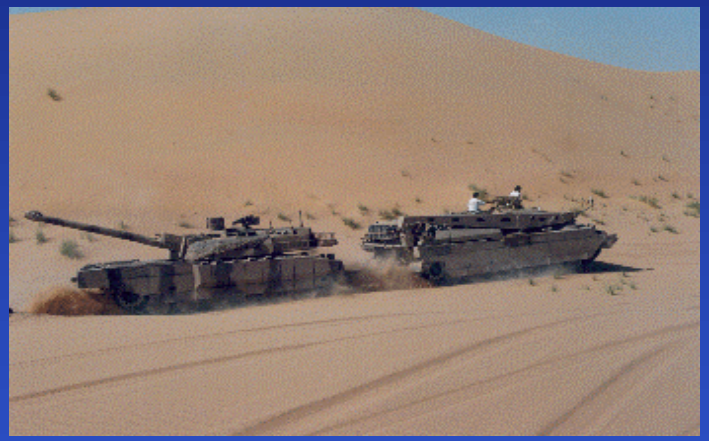
By insuring our vehicles :

modularity

Reliability,

Value,

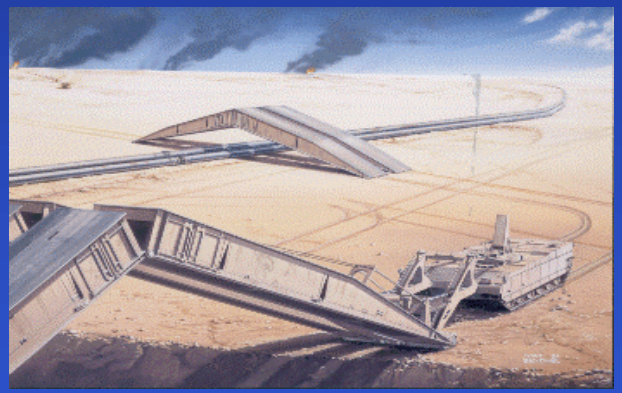
And easy Maintenance



To prepare the new configurations of our tanks and to imagine the tank of tomorrow

By developing new projects in order to :

increase the quality
of our vehicles,



create new concepts,

To evaluate our products against competitor's

Historic of the use of Adams at G.I.

1991 Giat Industries acquires Adams View and Solver

1992 First model of Wheeled Vehicle using Adams at G.I.

1993 Our first model of Tracked Vehicles using Adams and Ze-track

1997 First version of Adams/ATV by MDI (Sweden)

1999 Evaluation of ATV at G.I. And first full model of Tracked Vehicle

2000 End of ATV's evaluation

2001 Purchase of Adams/ATV .....

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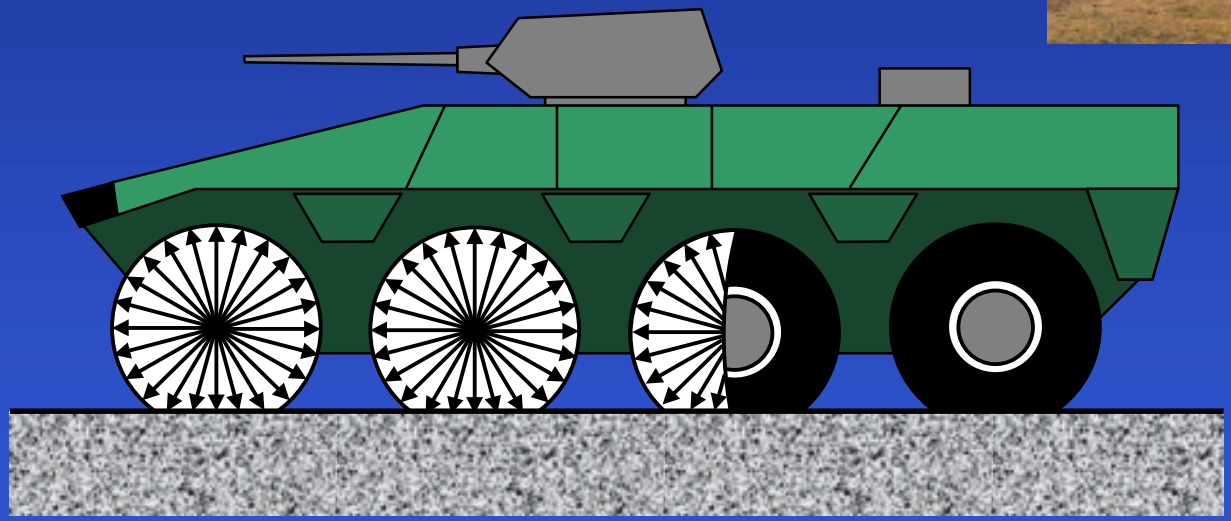
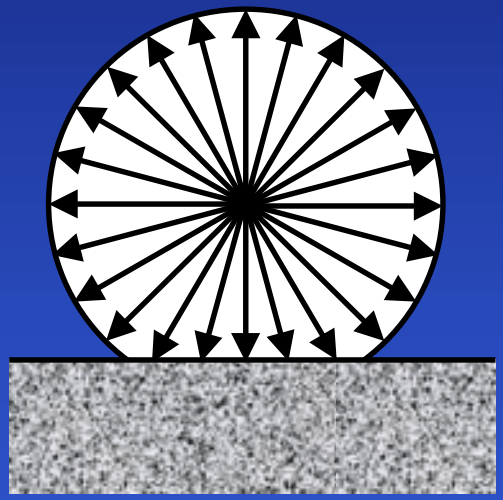
2- Numerical Simulation of Off-Road Vehicles using Adams software

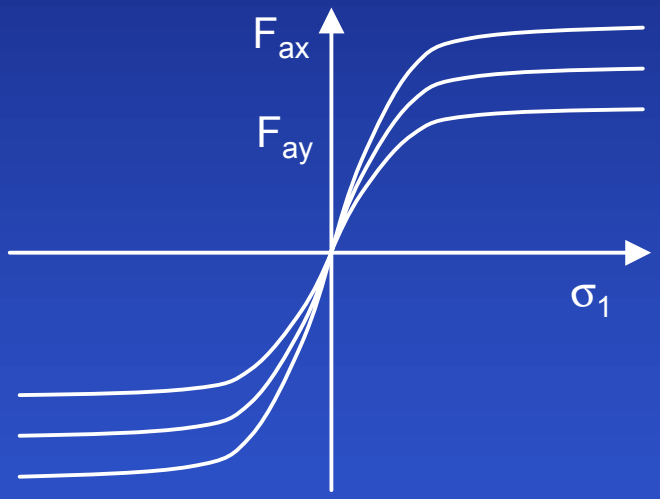
Model of an 8x8 off-road vehicle defined with Adams



A Specific sub-routine FORTRAN reproducing the tire behaviour is coupled with the Adams models as a Gfosub()



The radial stiffness is defined by a multiple radius contact wheel



The definition of contact forces is based on Pacejka formulation

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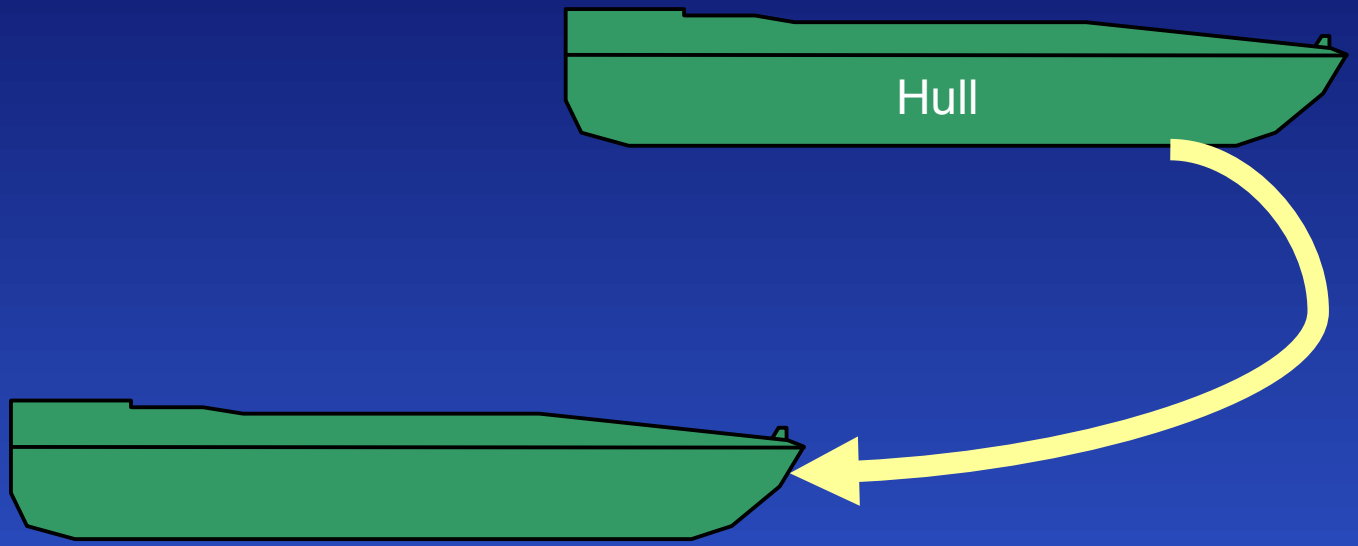
3.1- Presentation of a high mobility tracked vehicle

3.2- Modelisation of a tracked vehicle with the G.I. program Ze-track

3.3- Modelisation of a tracked vehicle with Adams plus ATV

3.11

Sub-systems of a Tracked Vehicle



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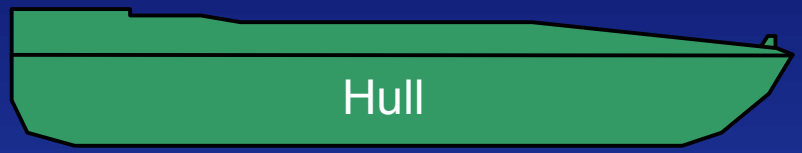

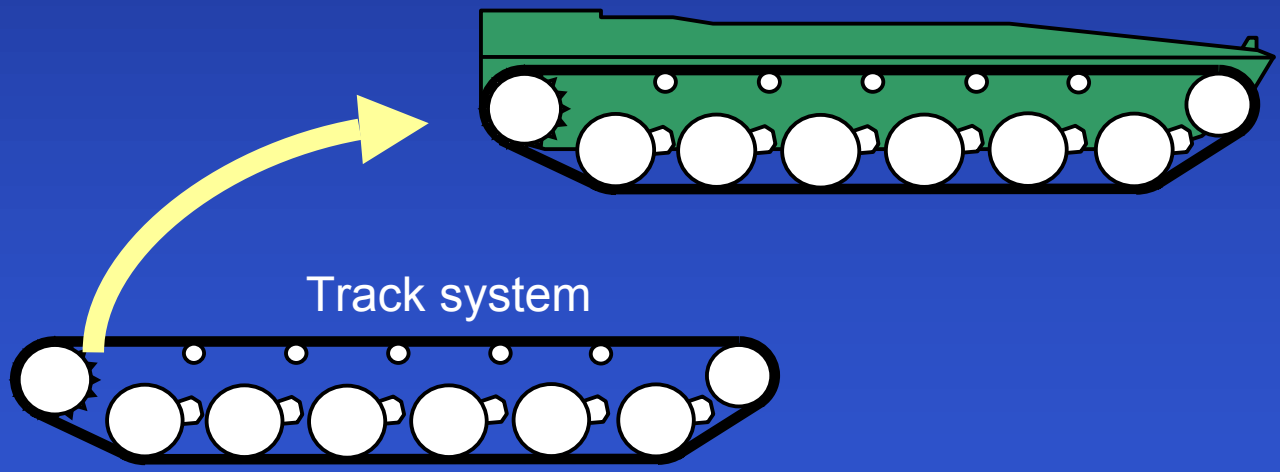

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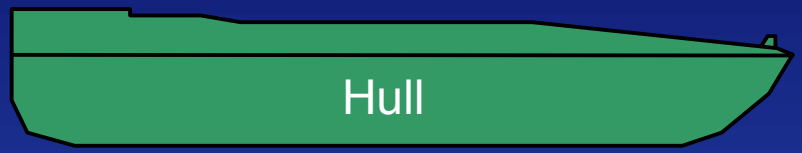
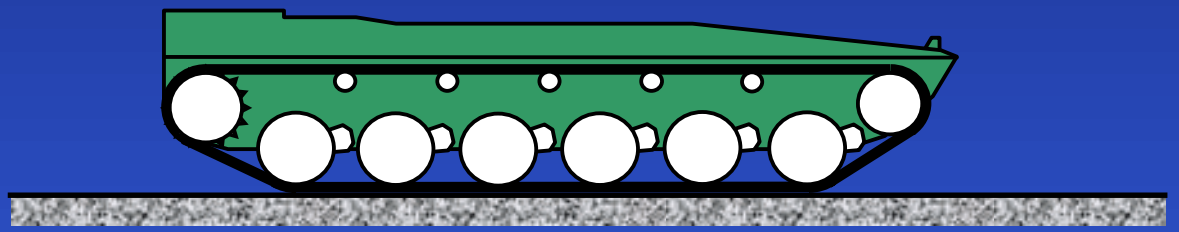
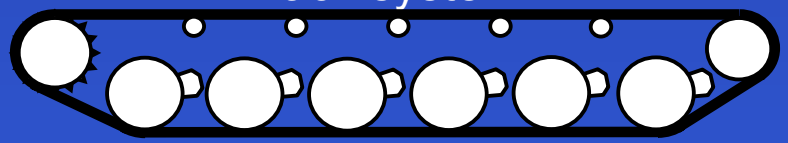
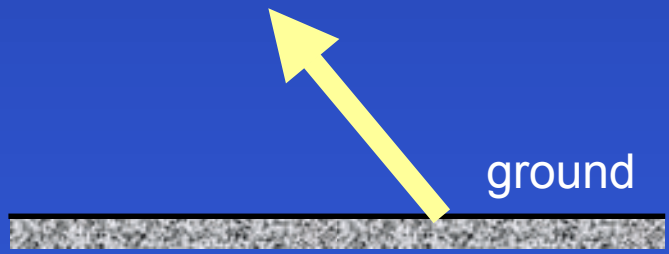




Track system





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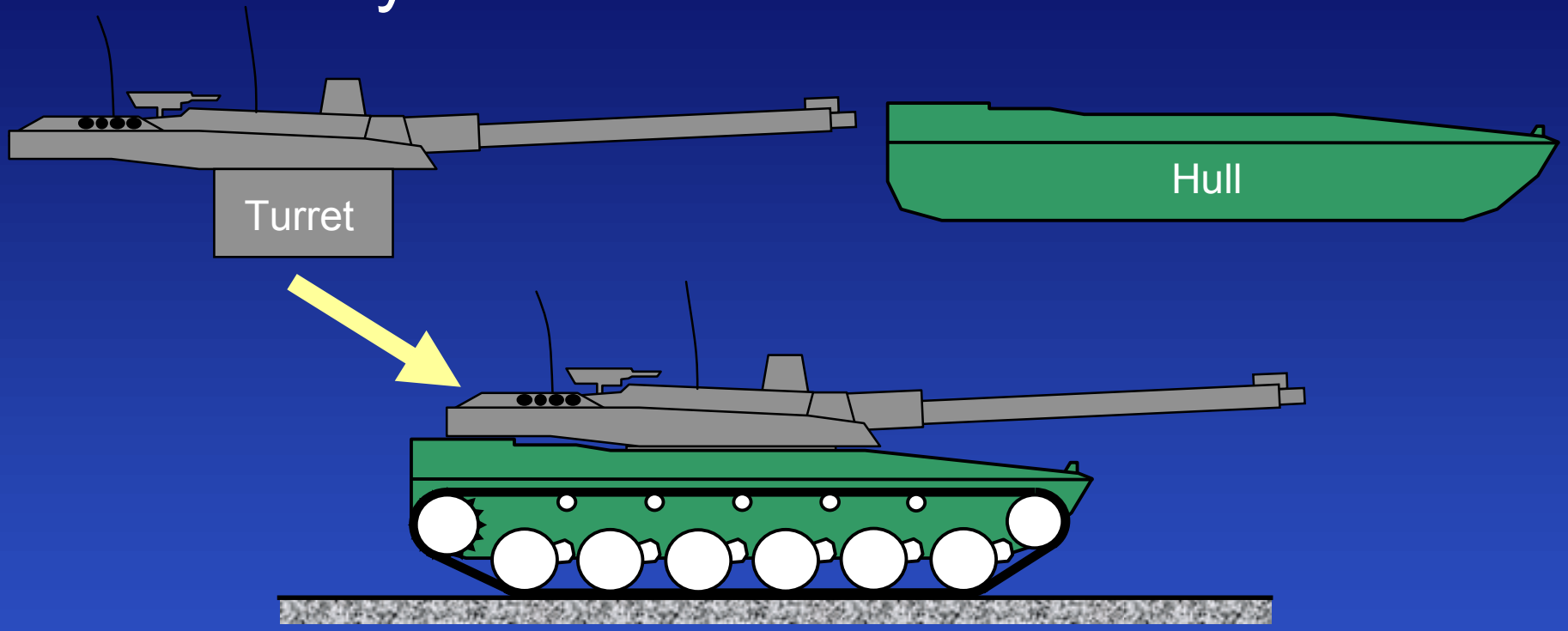
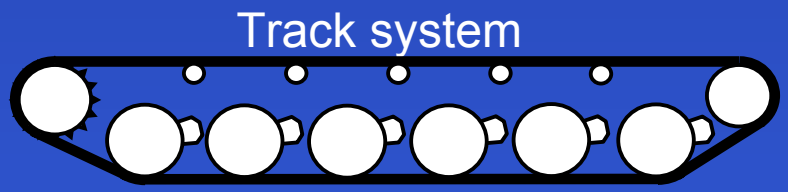
Sub-systems of a Tracked Vehicle





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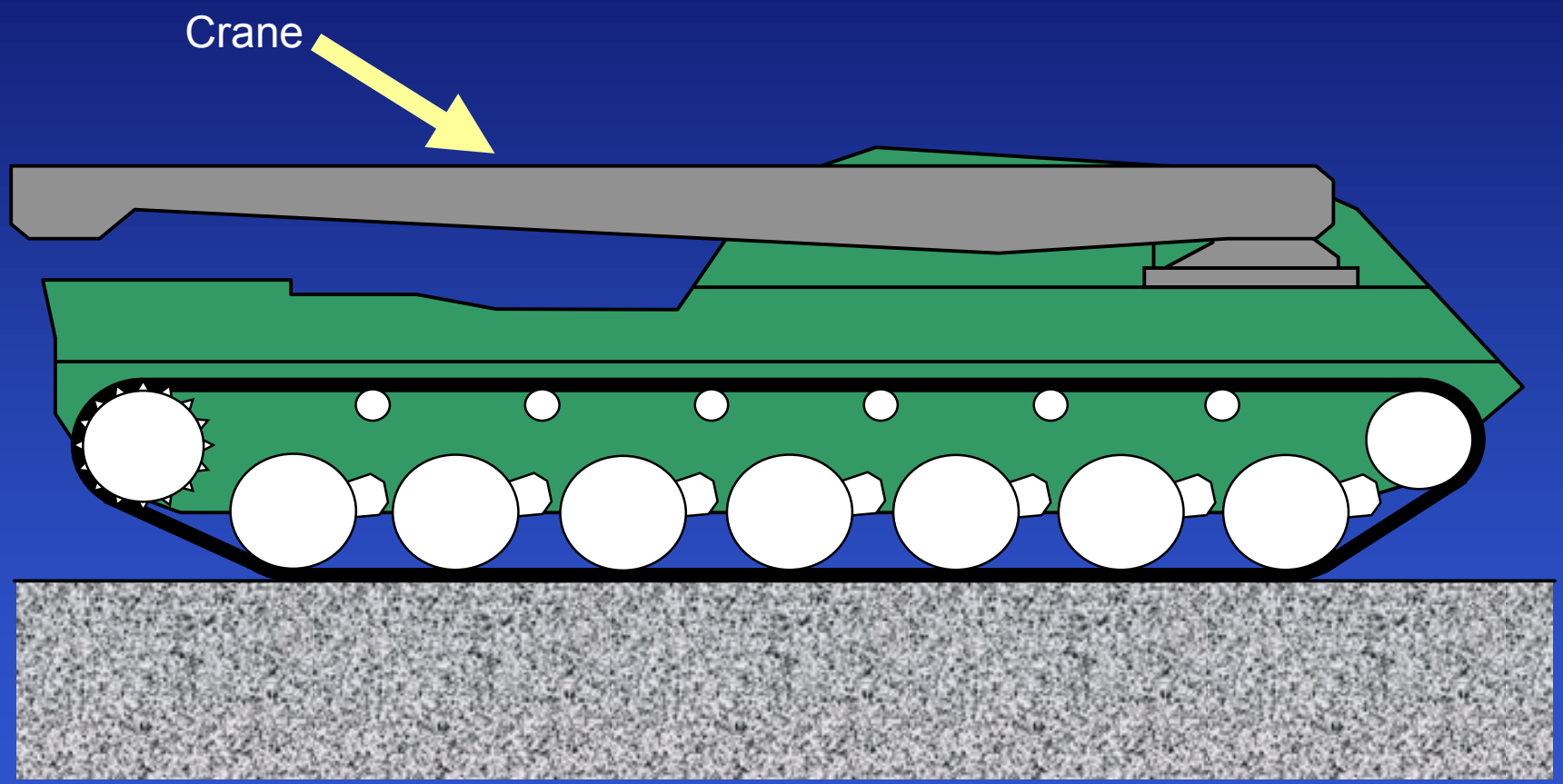
Sub-systems of a Tracked Vehicle



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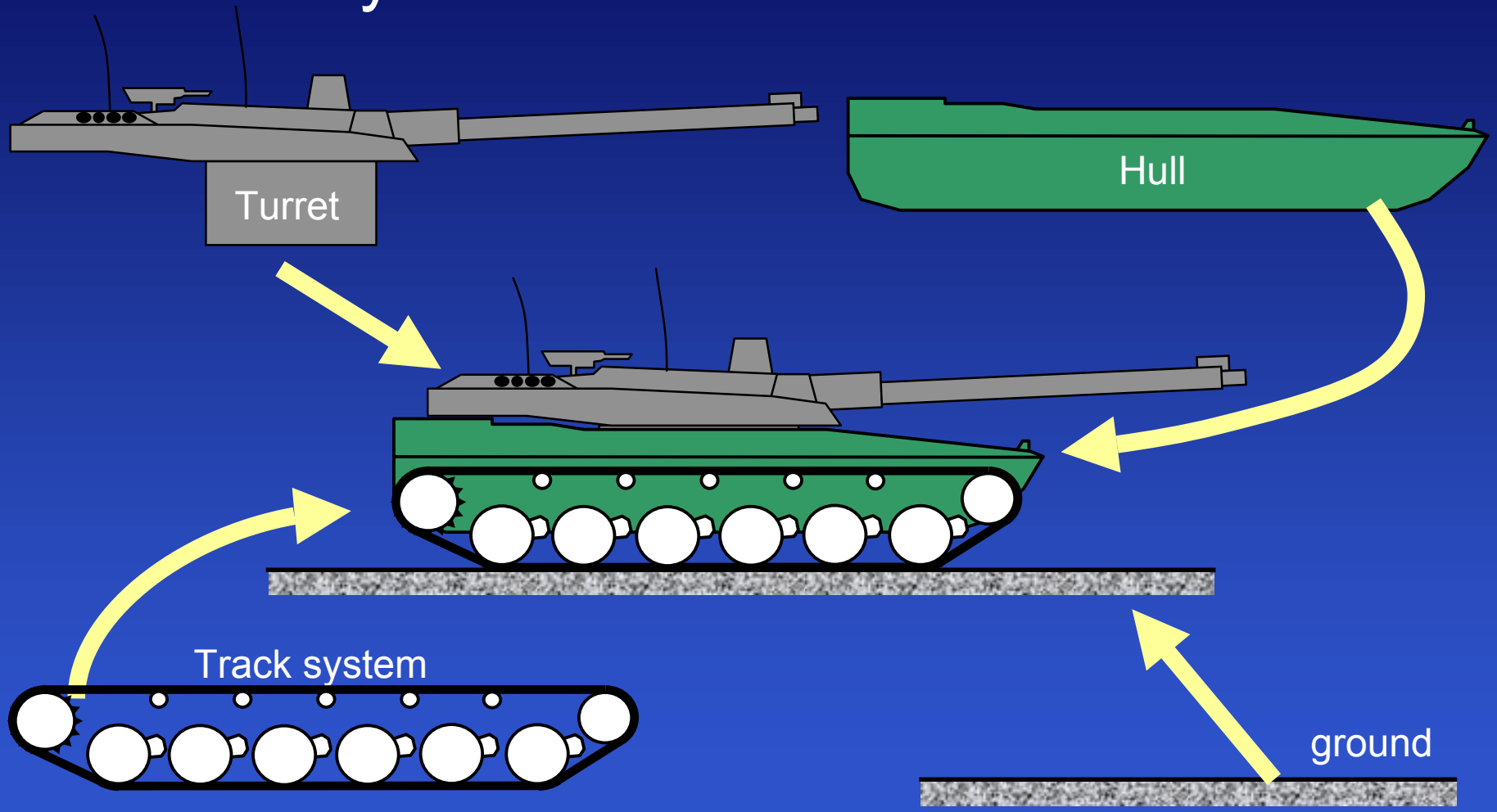
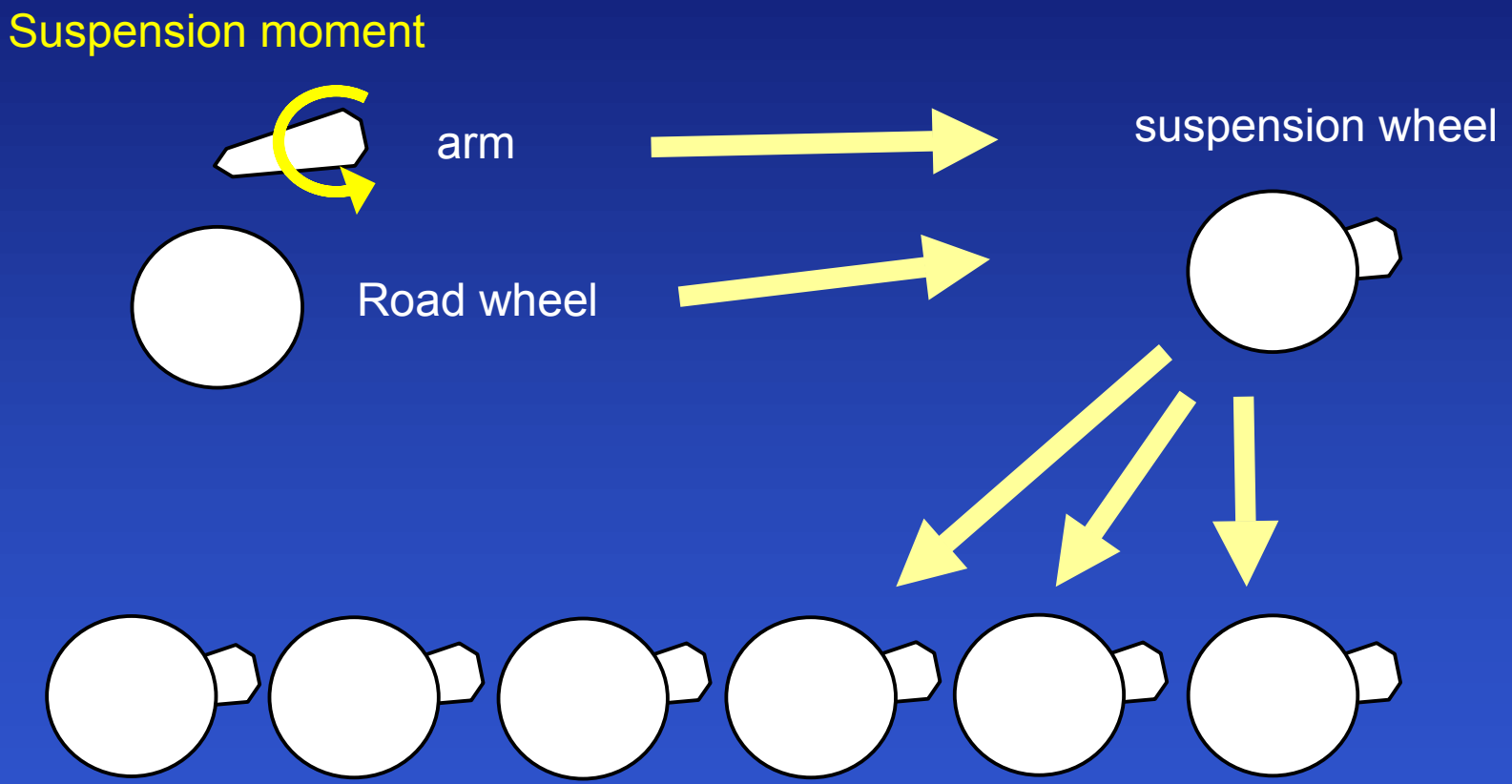
Sub-systems of a Tracked Vehicle

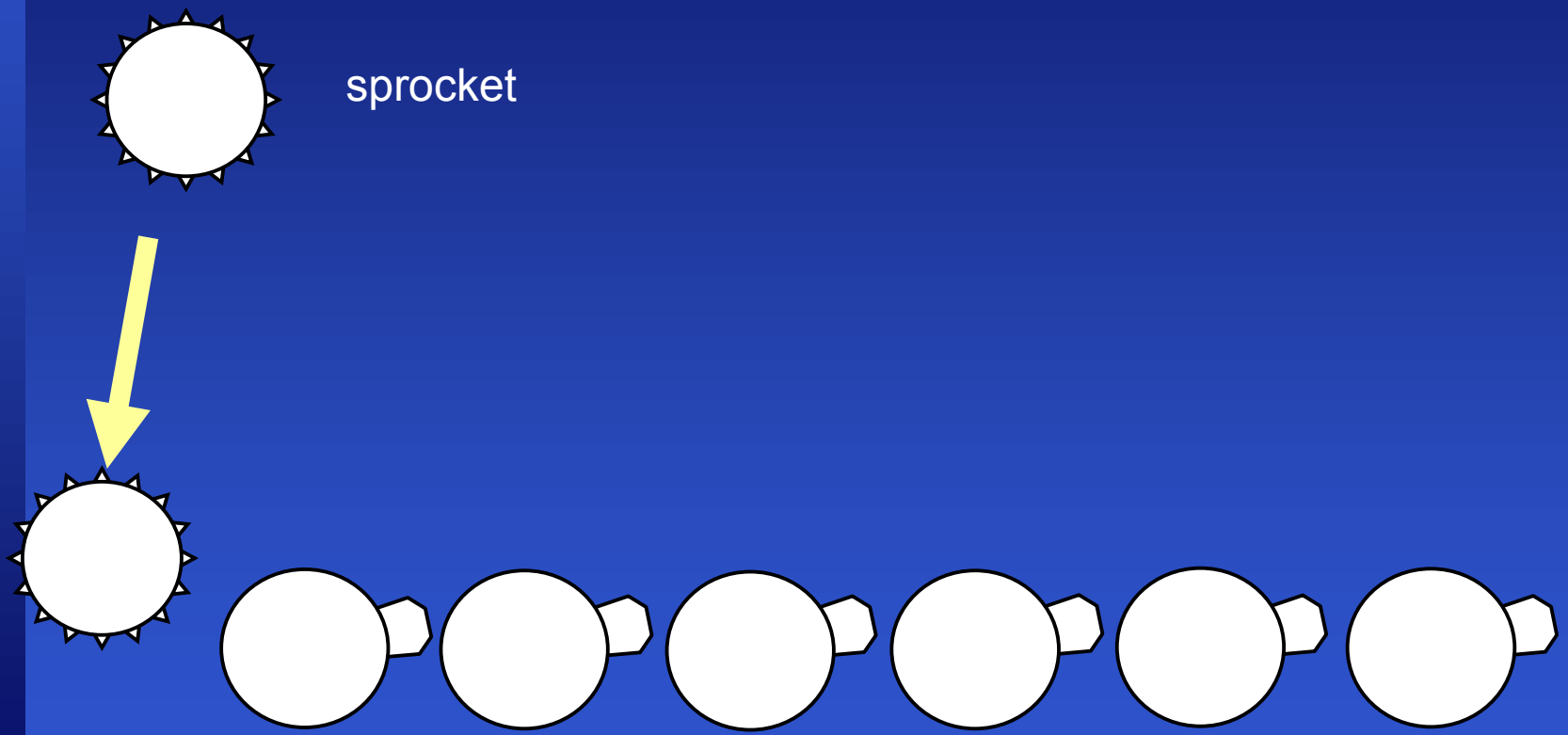


Track System Description



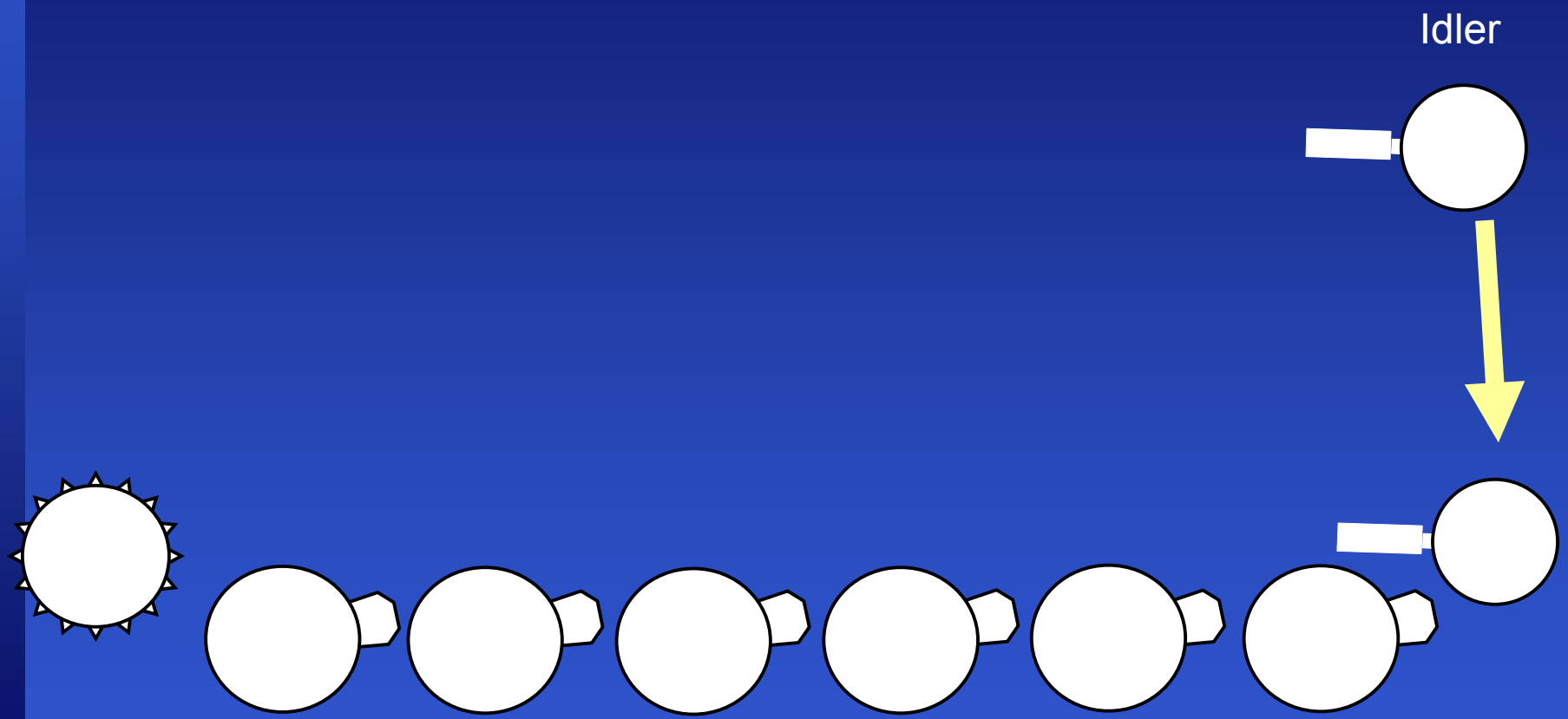
3.12

Track System Description



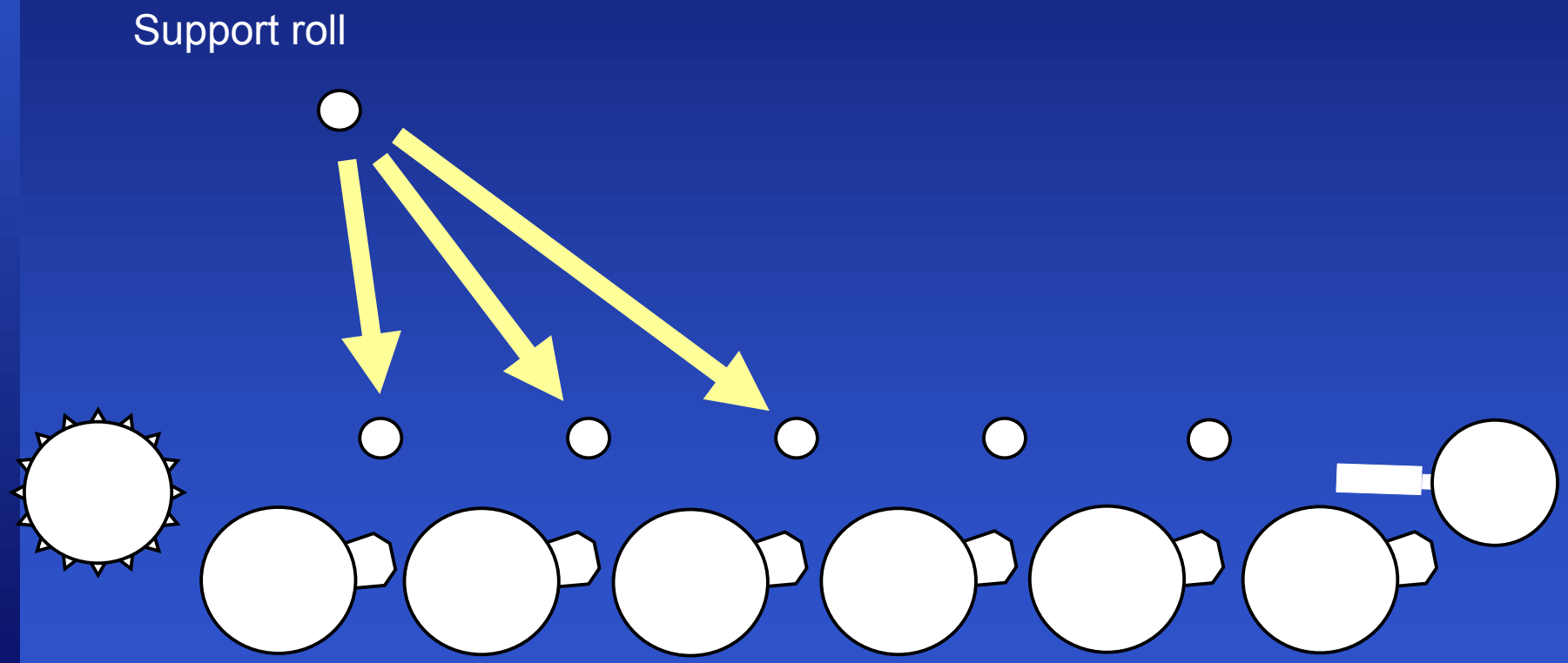
3.12

Track System Description



3.12

Track System Description



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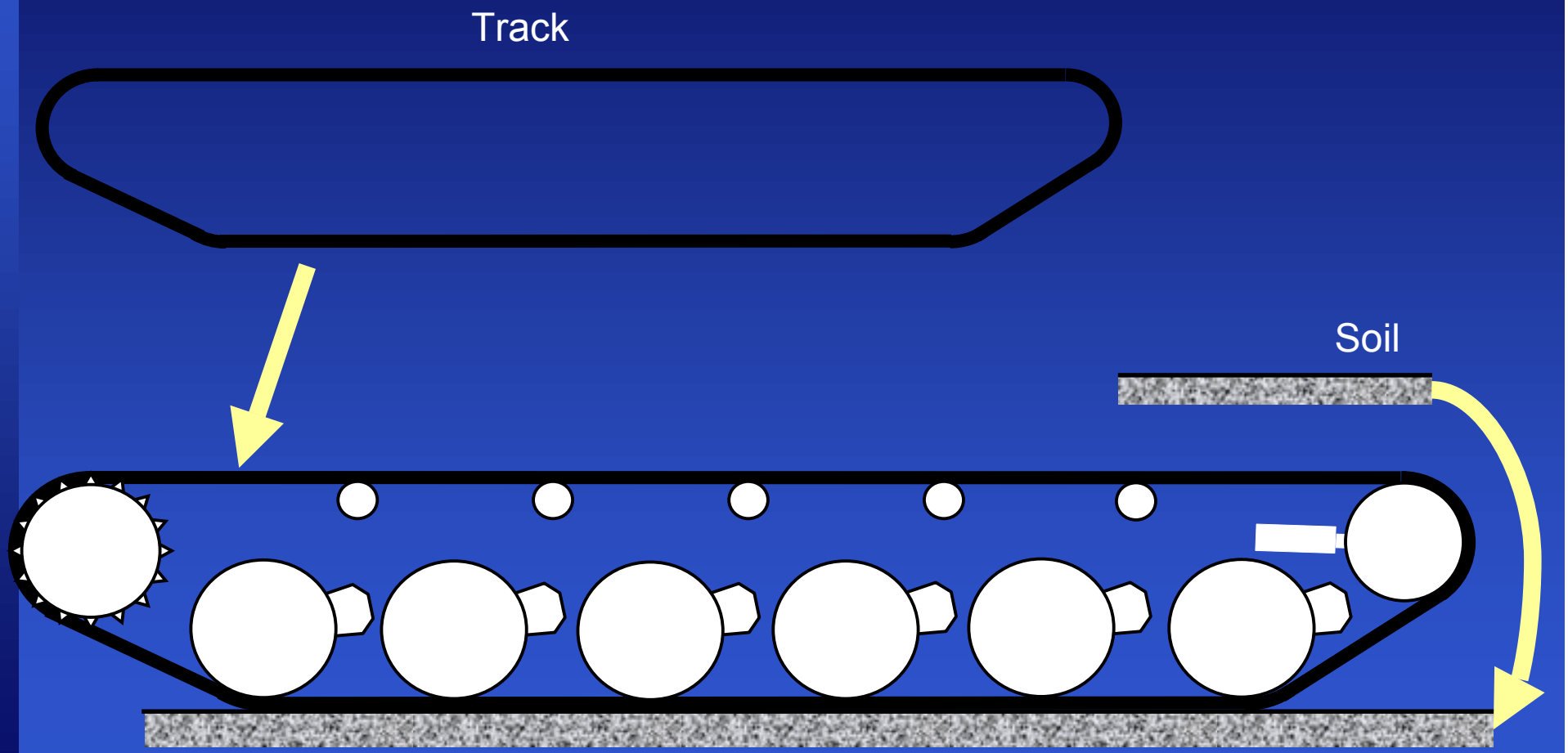
Track System Description



3- Numerical Simulation of Tracked Vehicles using ADAMS software

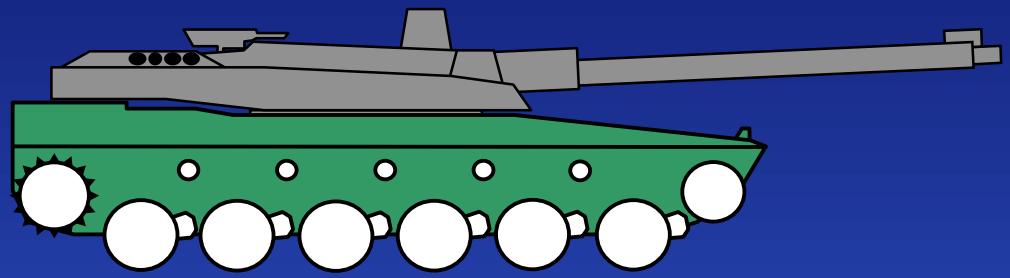
3.1- Presentation of a high mobility tracked vehicle

3.2- Modelisation of a tracked vehicle with the G.I. program Ze-track

3.3- Modelisation of a tracked vehicle with Adams plus ATV

3.2- Modelisation of a tracked vehicle with the G.I. program Ze-track

1- Creating a vehicle in Adams

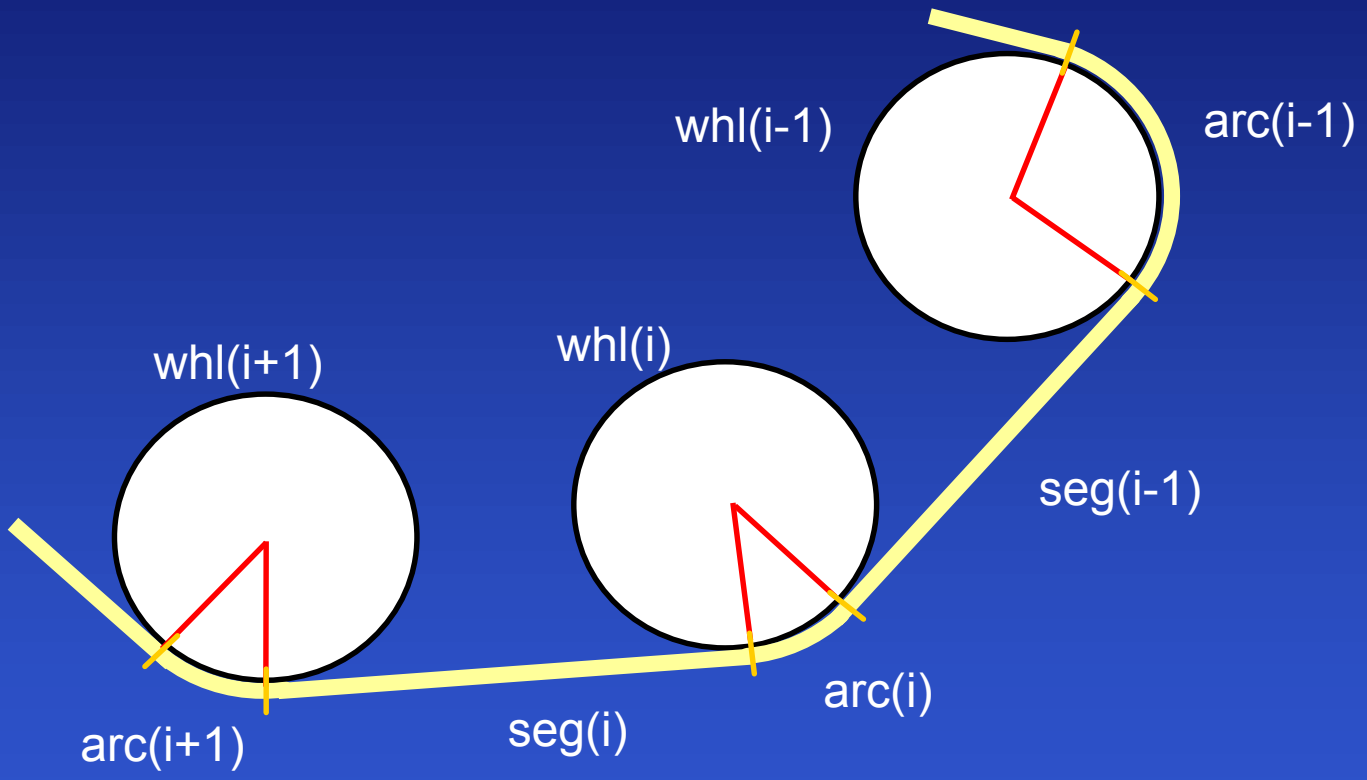


2- Creating the G-forces calling the subroutine Ze-track

All actions of the track
on the components of the vehicle
are calculated and applied with the FORTRAN program (Ze-track)

3.21

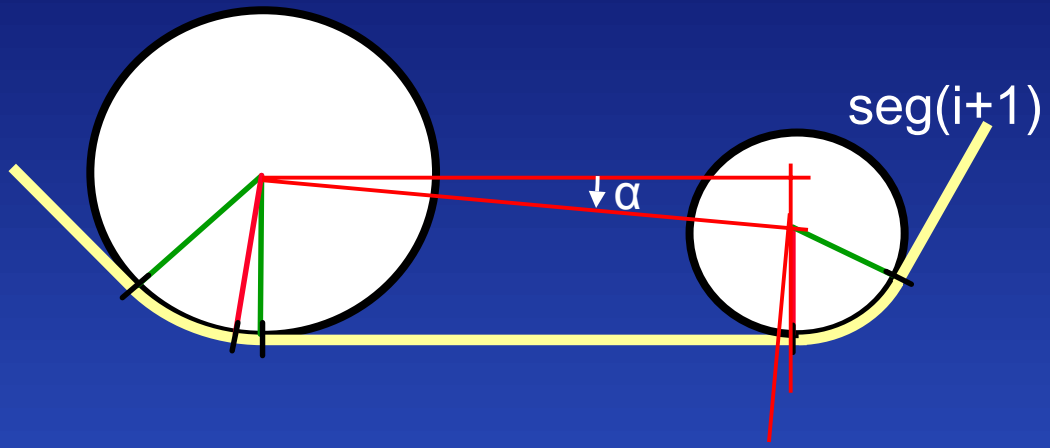
Definition of the length for every part of the track

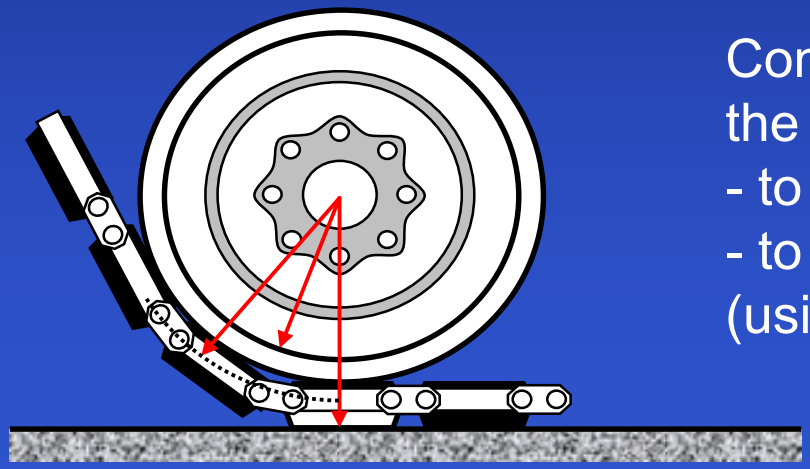


3.22

Determination of radiuses

For linear and curve segments
Especially if the wheels have different radiuses

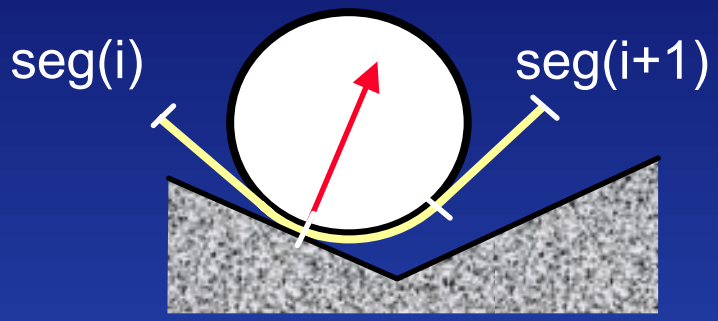


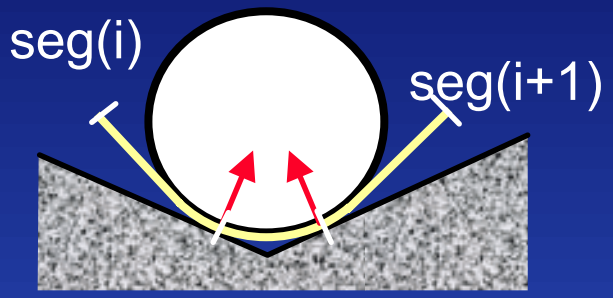


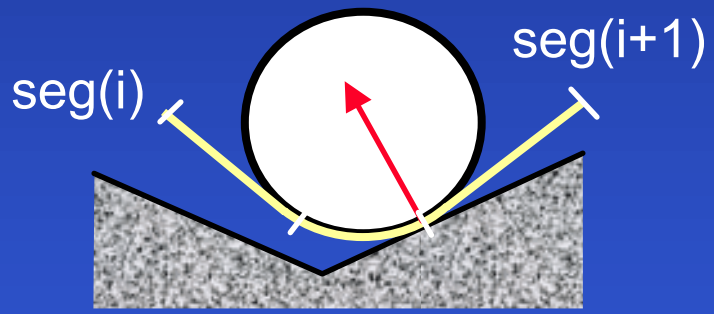
Considering the real distance between the centre of the wheel :
- to the soil
- to the track rolling-up circle (using pad thickness)

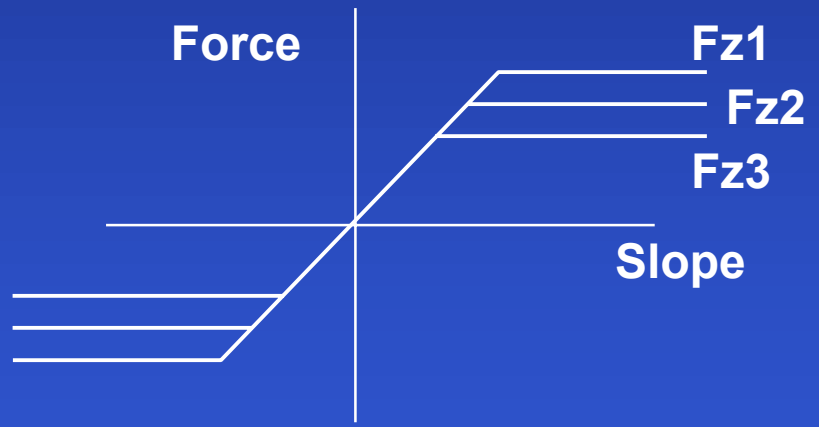
3.23

Distribution of Forces induced by multiple contacts

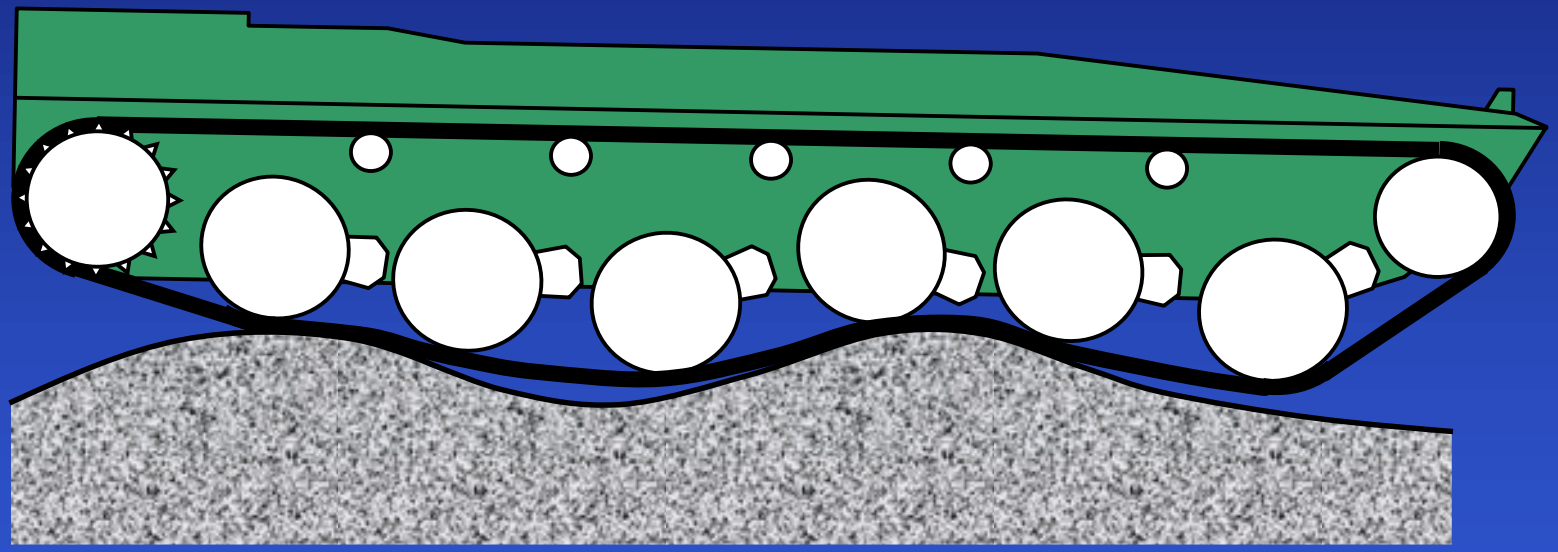




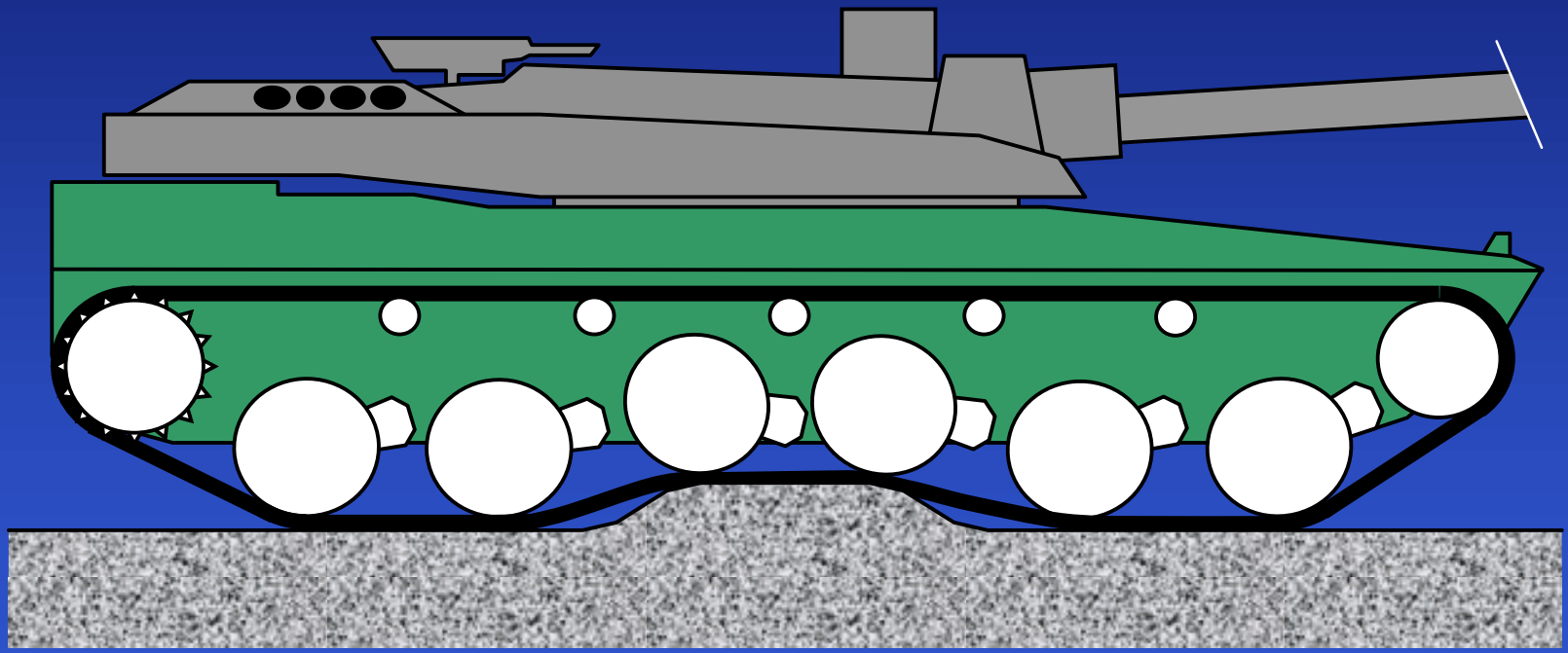




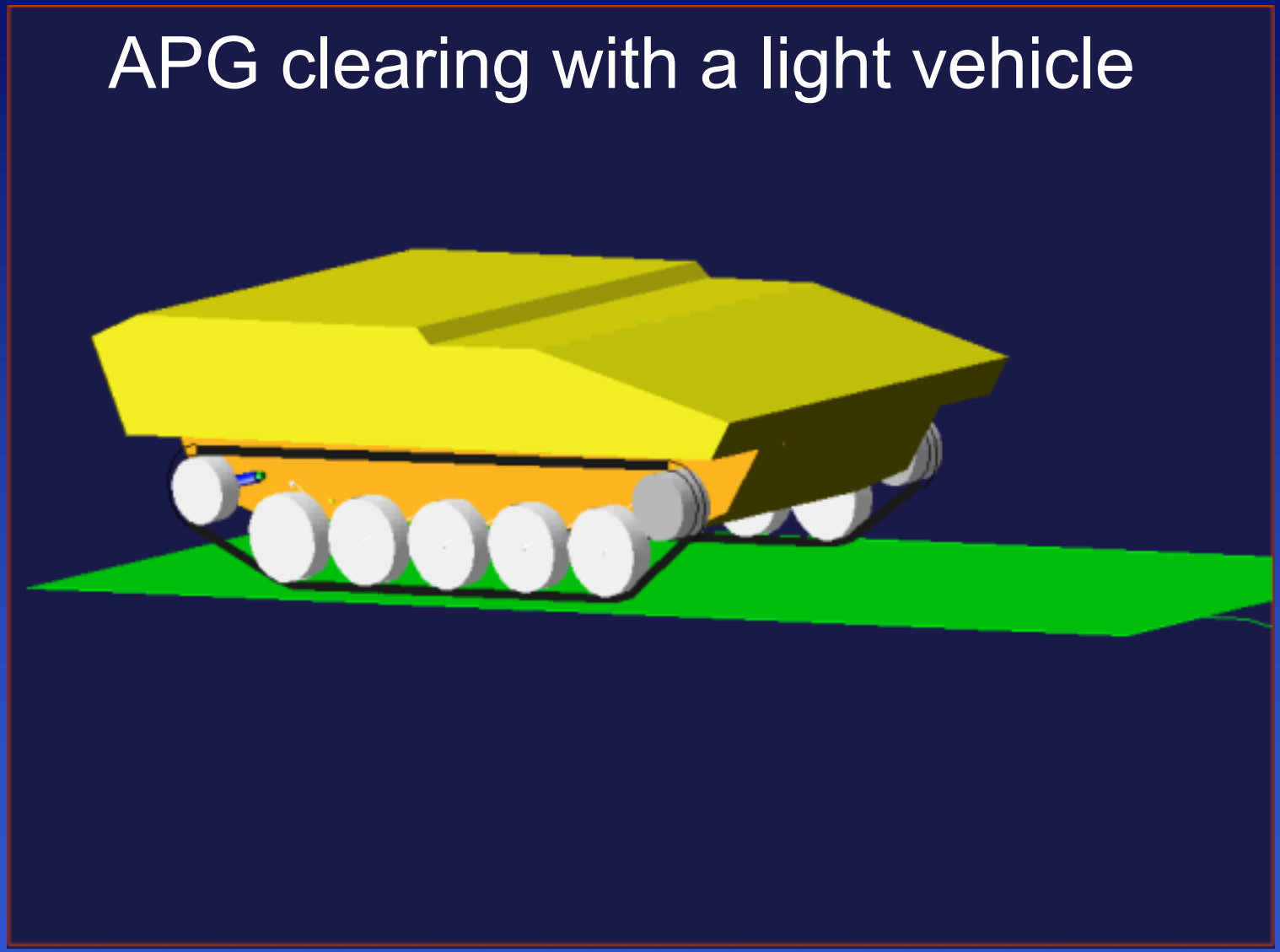
Rolling on rough terrain controlling road-wheel ground contact



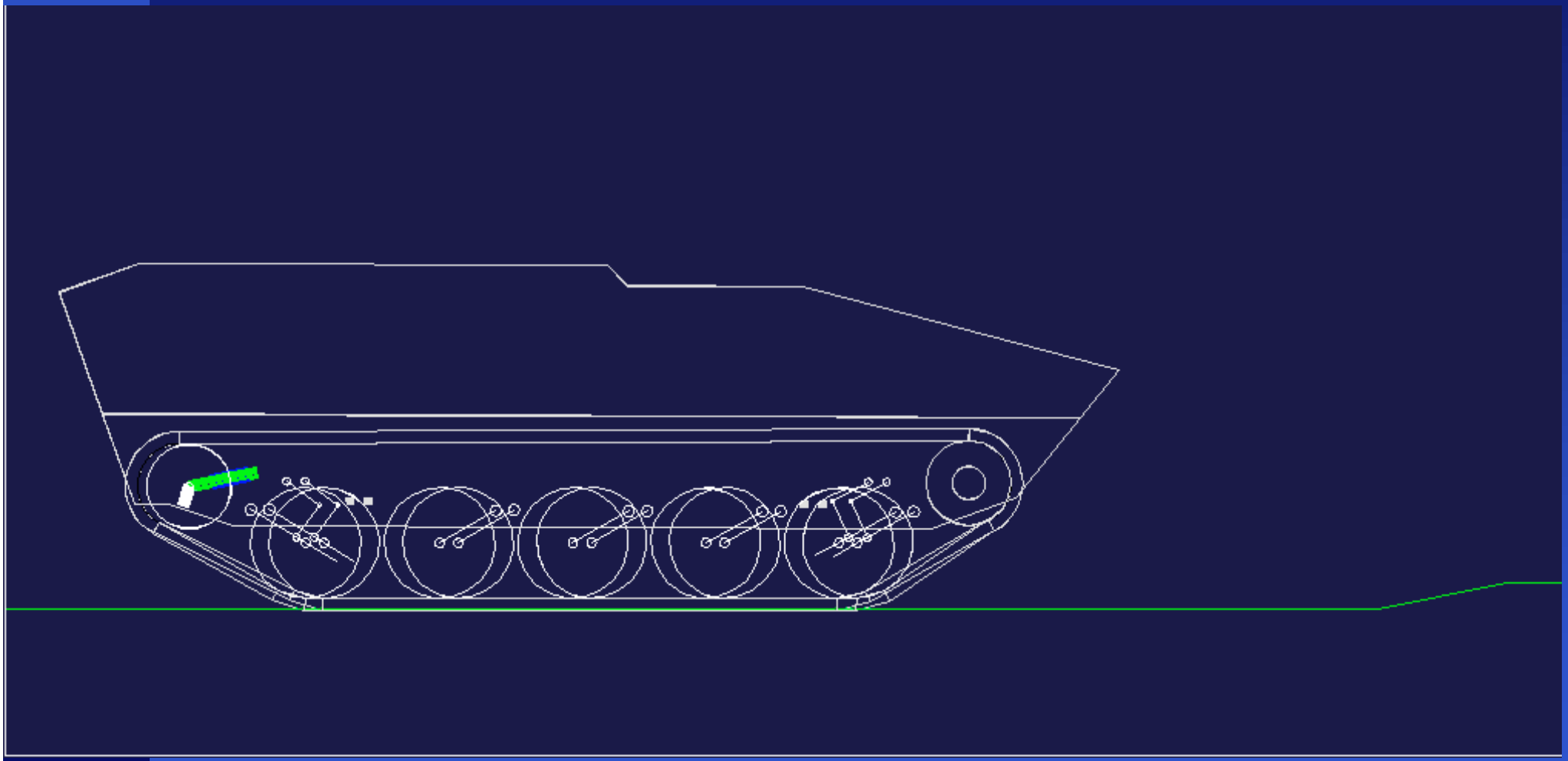
APG clearing



APG clearing with a light vehicle

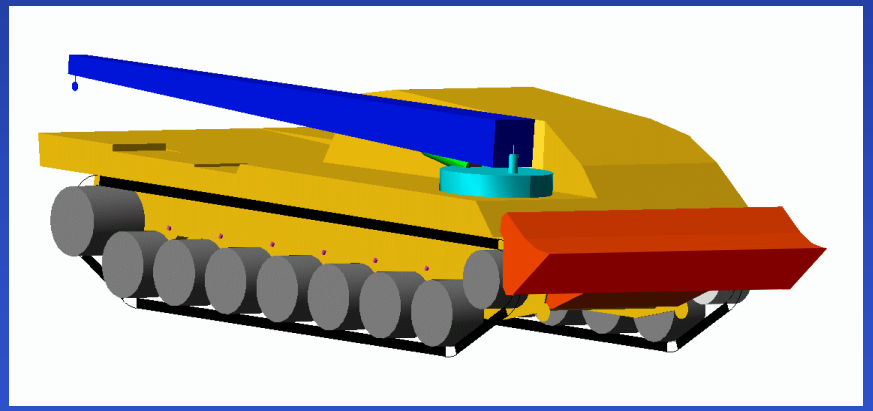


APG clearing with a light vehicle



Quasi-static simulations

Crane Simulation



3- Numerical Simulation of Tracked Vehicles using ADAMS software

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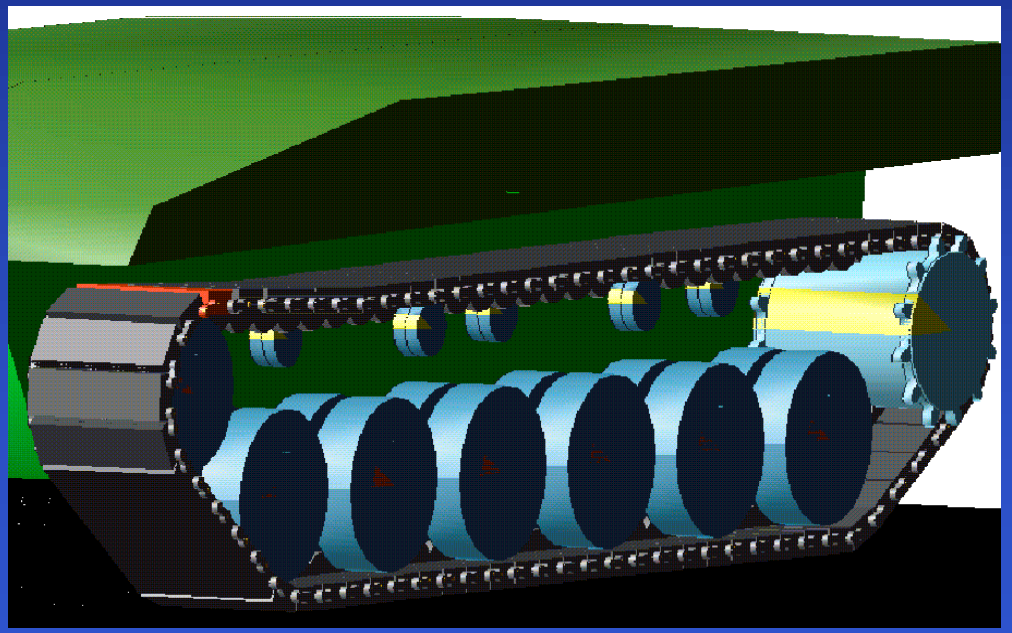
The Numerical Simulation of Tracked Vehicles using Adams/ATV software

- Creation of a full vehicle in Adams

- The track is completely defined, including a fine description of :
  - shoes, pads
  - connectors
  - links

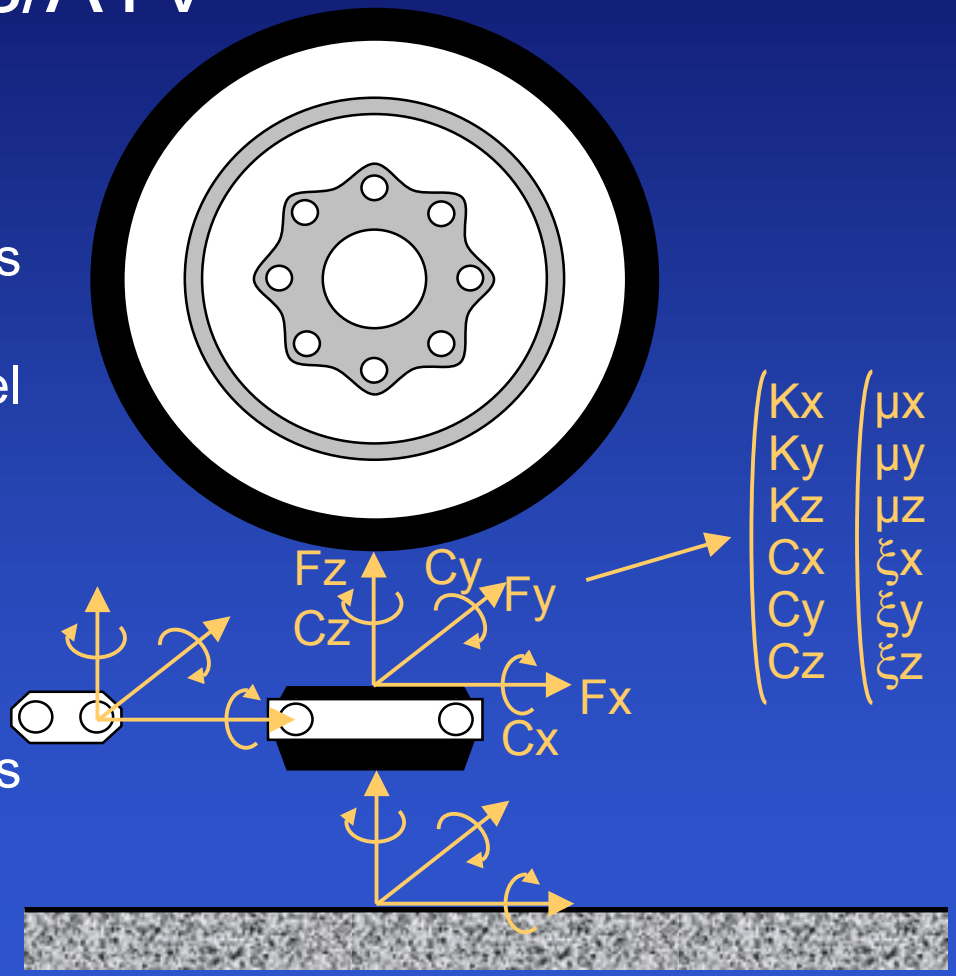
  - and all the forces acting :
    - between parts
    - in track links
    - between track and the soil or the hull.



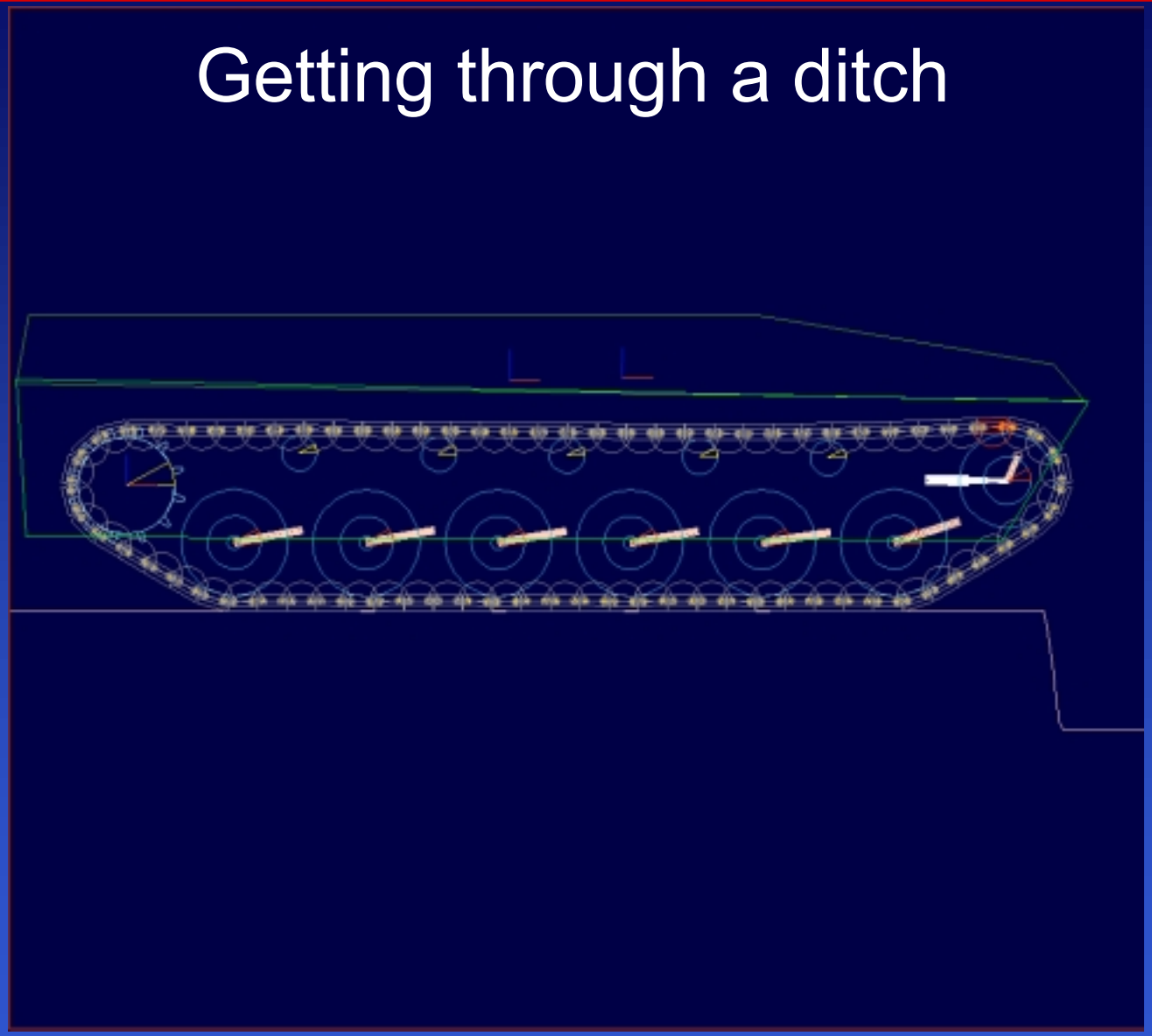
Description of Track relationships in Adams/ATV

- complete forces acting :

  - forces between shoe and connectors
  - forces between shoe and road wheel
  - forces between shoe and soil
  - forces between shoe and hull
  - forces between shoe and connectors
  - forces between shoe and sproket



Getting through a ditch



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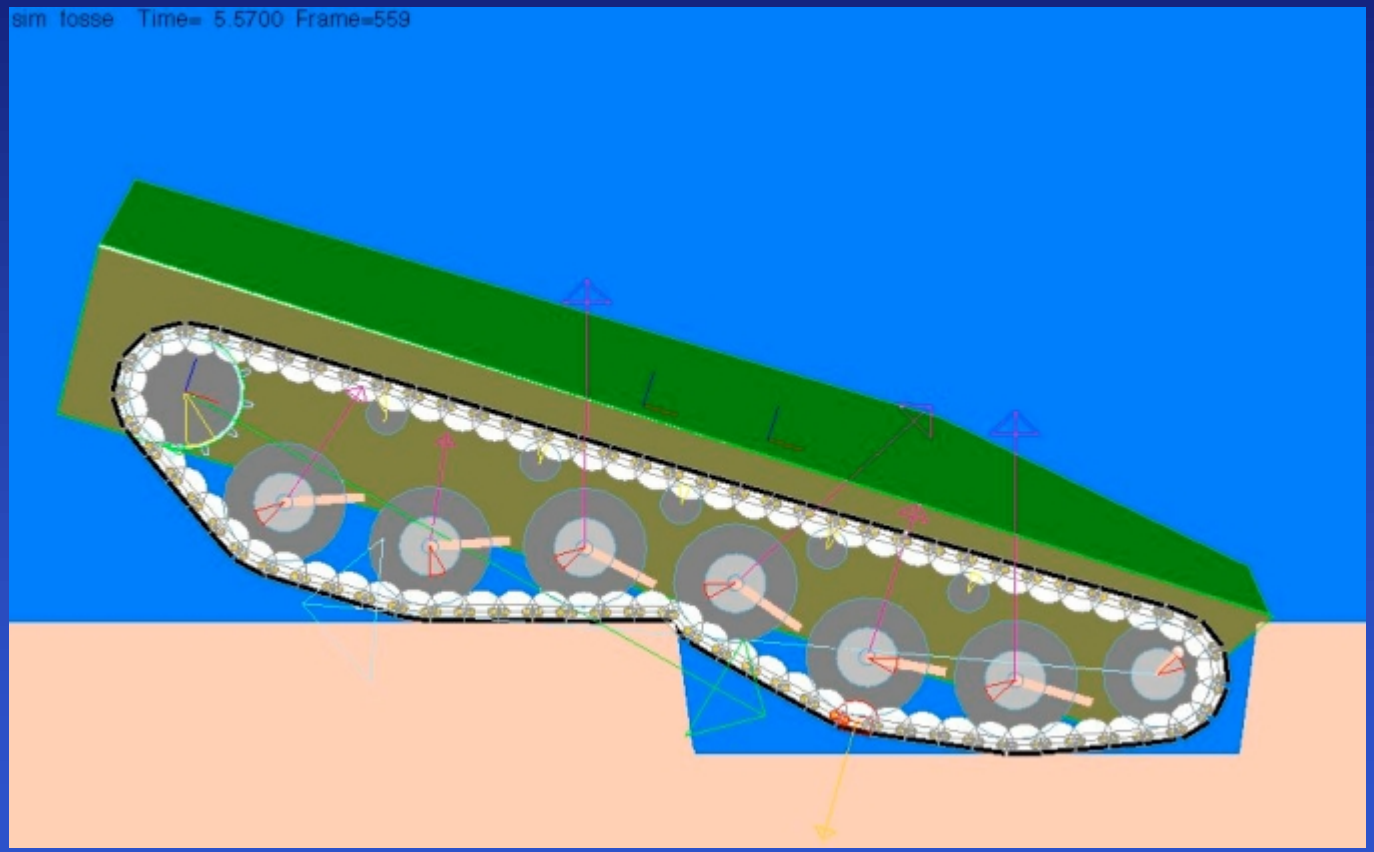
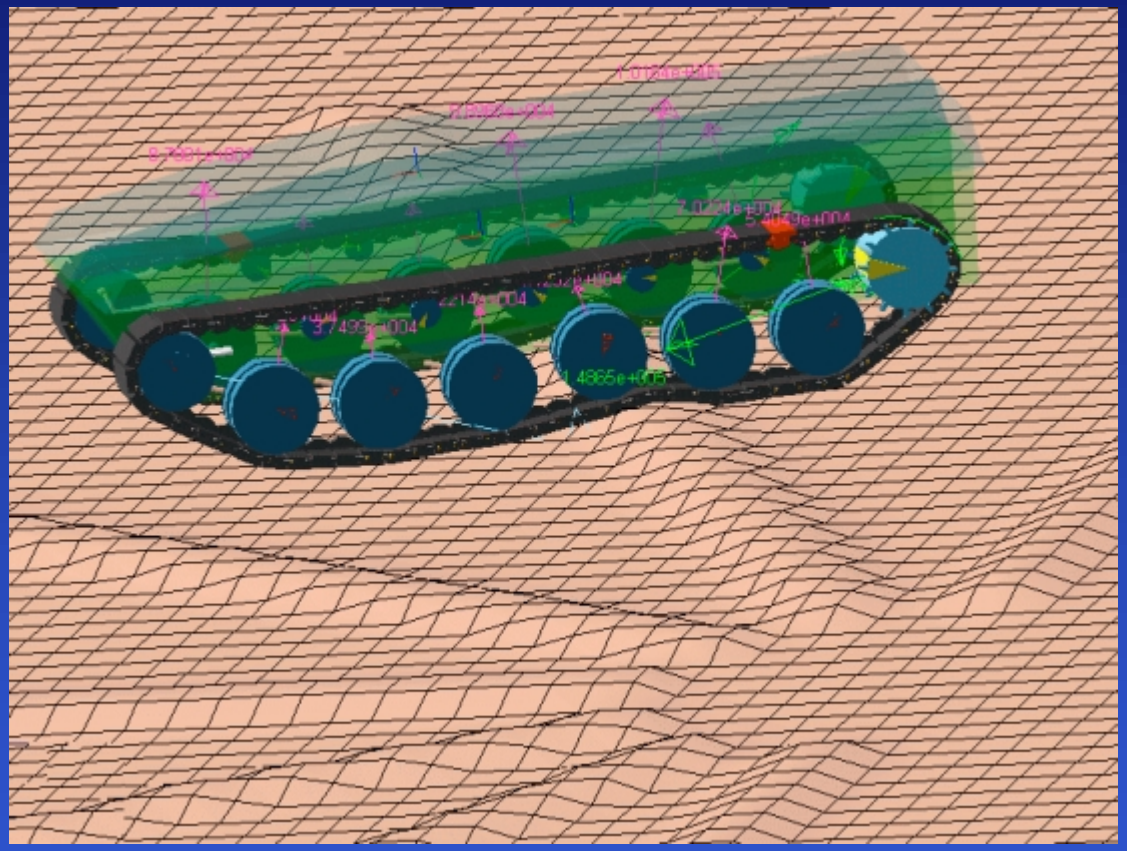
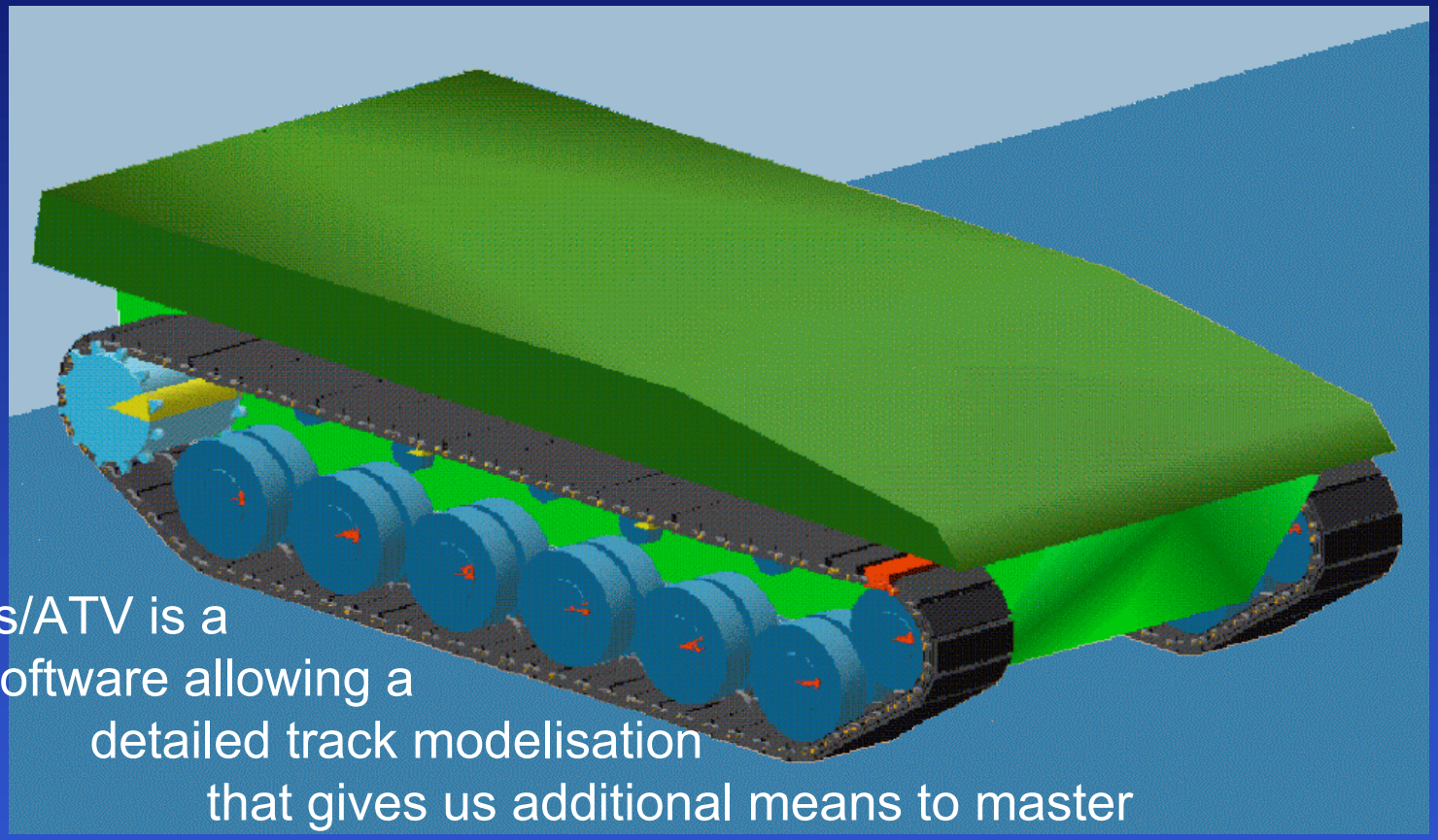


Testing the dynamic behaviour on a rough terrain



Why we have chosen ATV



Adams/ATV is a
software allowing a
detailed track modelisation
that gives us additional means to master
the complex dynamic behaviour of tracked vehicles