

SVILUPPO DI METODOLOGIE INFORMATICHE PER IL REVERSE ENGINEERING DEL CORPO UMANO

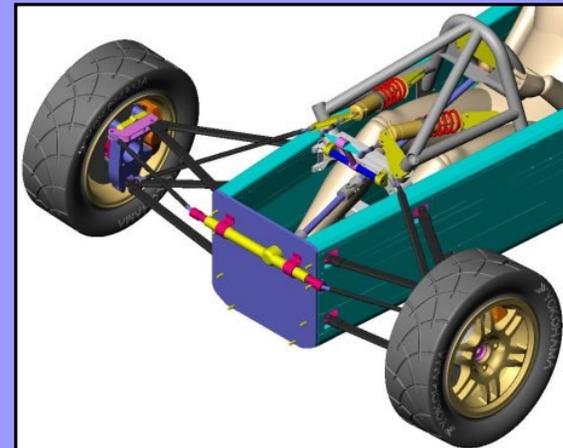
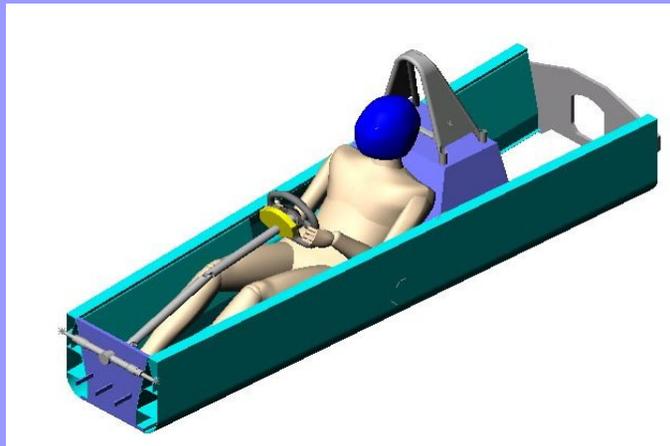
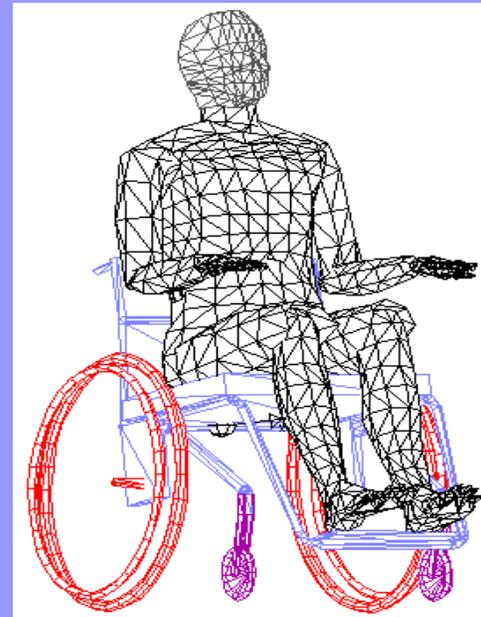
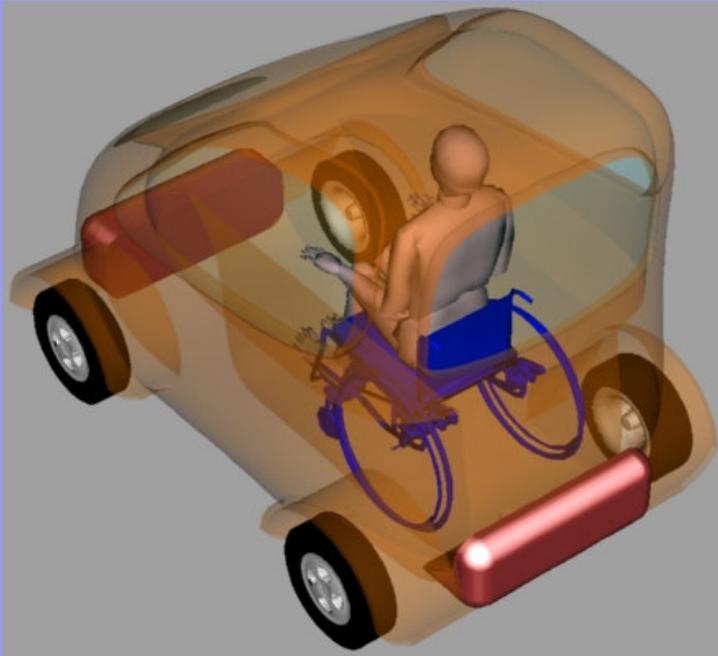


Università degli Studi di Brescia
Dipartimento di Ingegneria Meccanica

Sviluppo di metodologie informatiche per il
Reverse Engineering del corpo umano.

Valerio Manenti
Relazione di Dottorato 3° anno

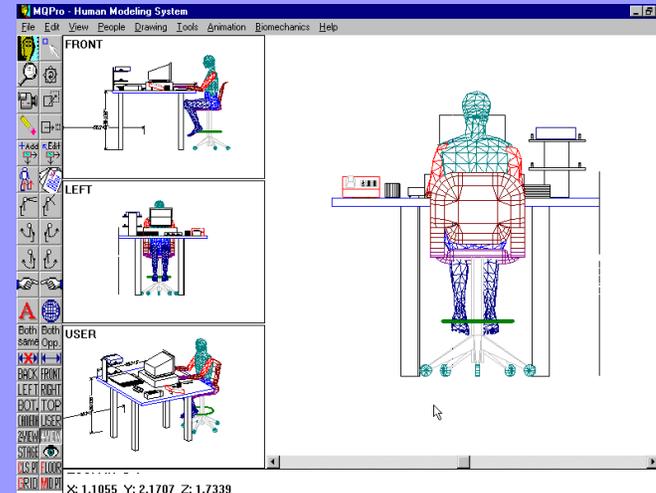
A) Disegno di macchine con importante interfaccia con l'uomo



A) Solidworks Add-in: Software in Commercio



Modelli per animazione
(Poser, 3DStudio, ecc.)

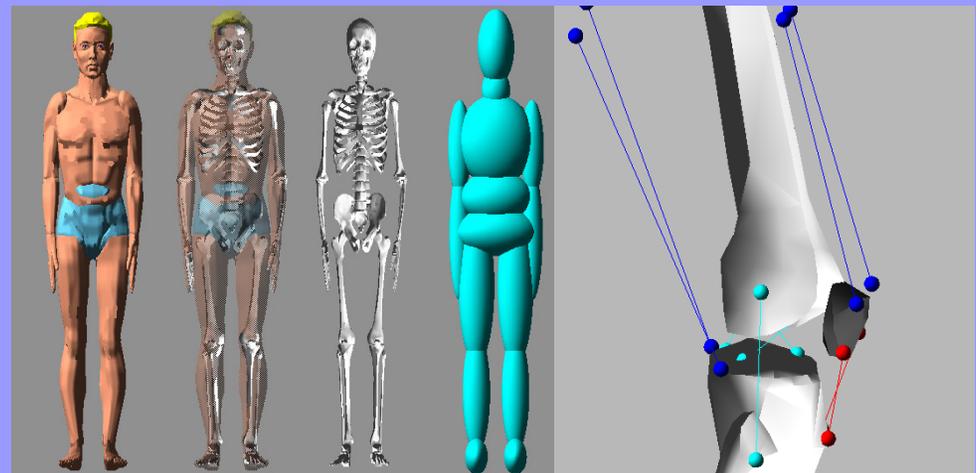


ManneQuin Pro - NexGen Ergonomics
Software CAE per analisi di ergonomia

Figure - MDI; Software CAE per
analisi di ergonomia,
cinematica e dinamica



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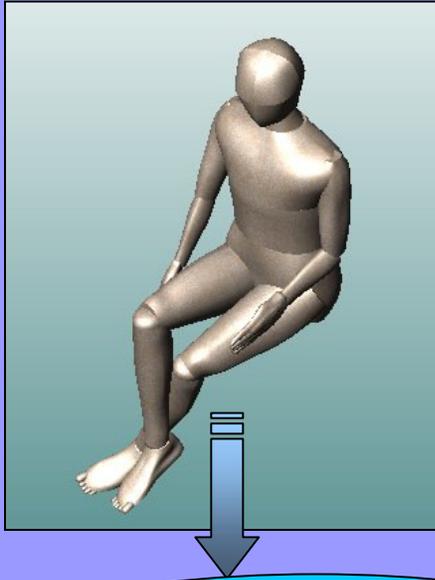


Sviluppo di metodologie informatiche per il
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Relazione di Dottorato 3° anno

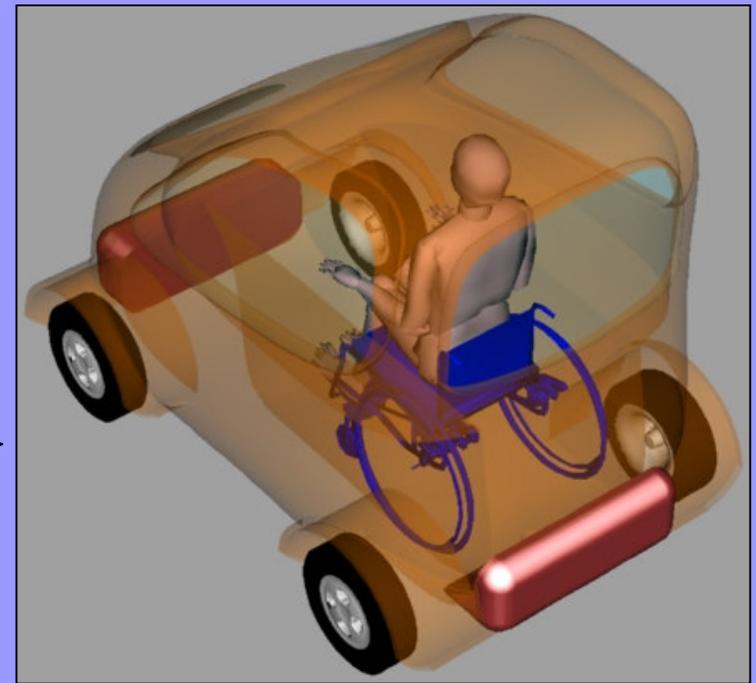
A) Solidworks Add-in: IDEA

Non creare un programma di ergonomia, ma definire uno strumento implementabile all'interno di un normale CAD 3D.



A) GENERATORE DI MODELLI UMANI

B) CAD 3D PARAMETRICO

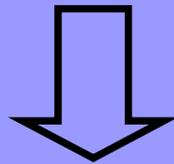


C) PROGETTO COMPLETO

A) Solidworks Add-in: Caratteristiche

Realizzazione di un tool integrato in SolidWorks:

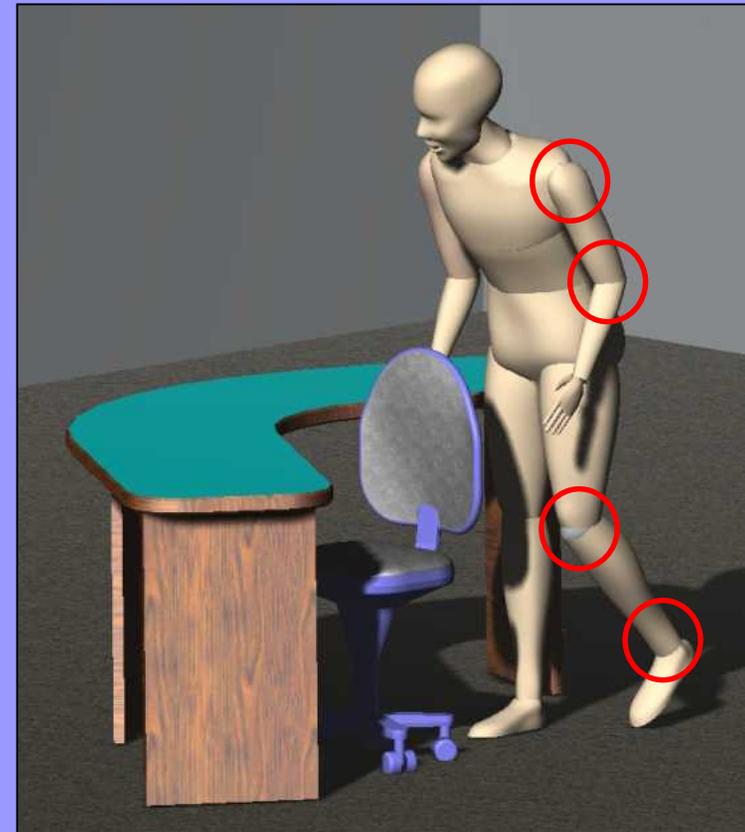
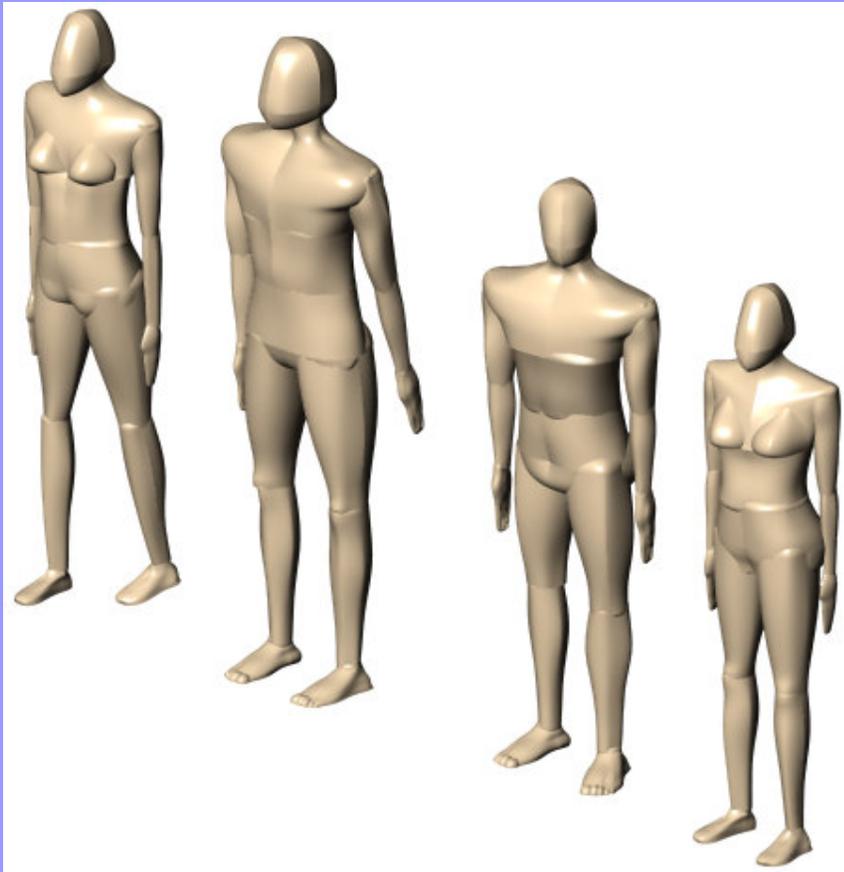
- 1. Flessibile**
- 2. Robusto**
- 3. Di facile manutenzione (correzione errori e inserimento nuove funzioni) anche da un NON programmatore.**



Soluzione :

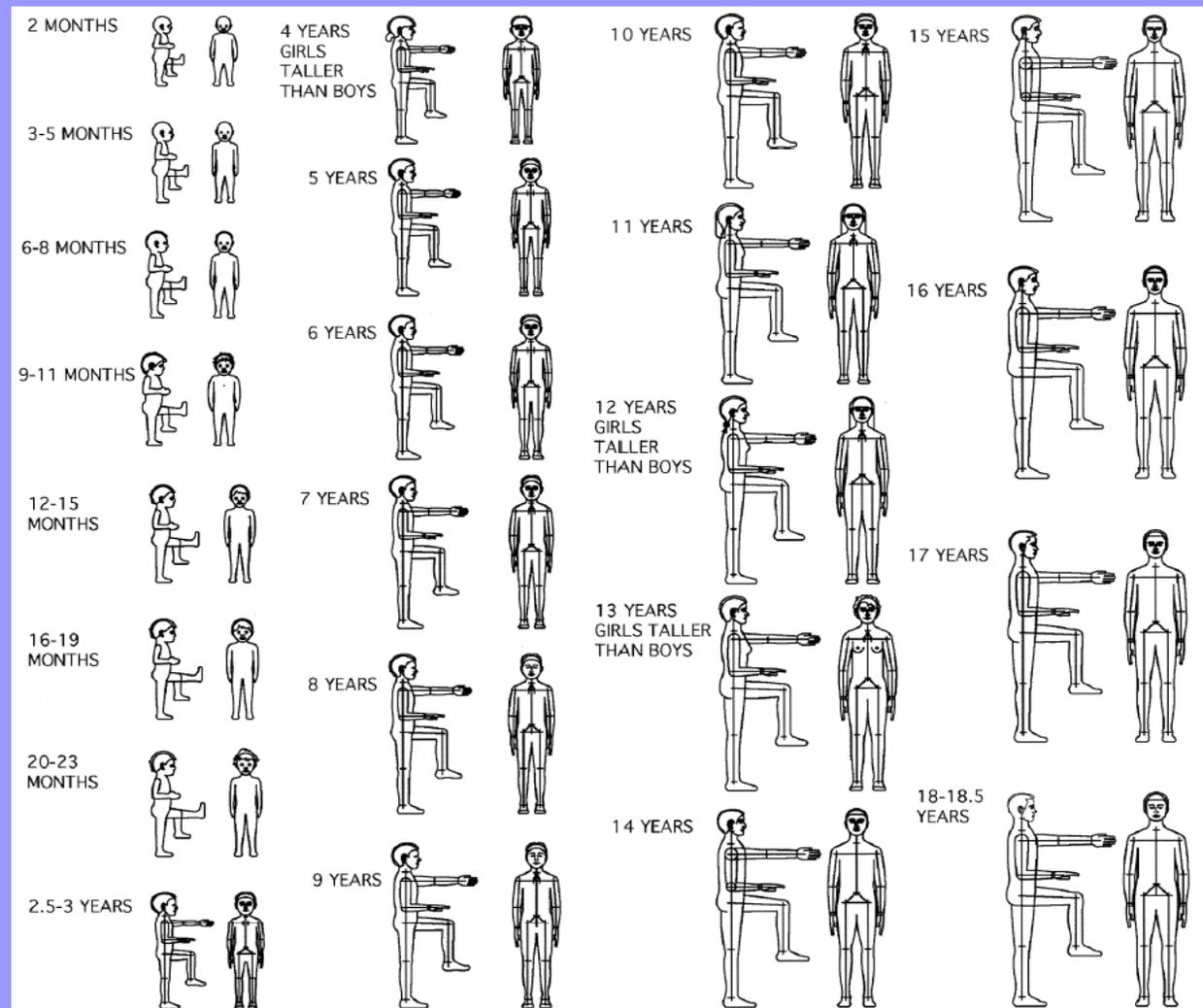
Creazione del manichino attraverso un add-in che richiama una macro implementata in Visual Basic

A) Solidworks Add-in: Limitazioni del modello esistente

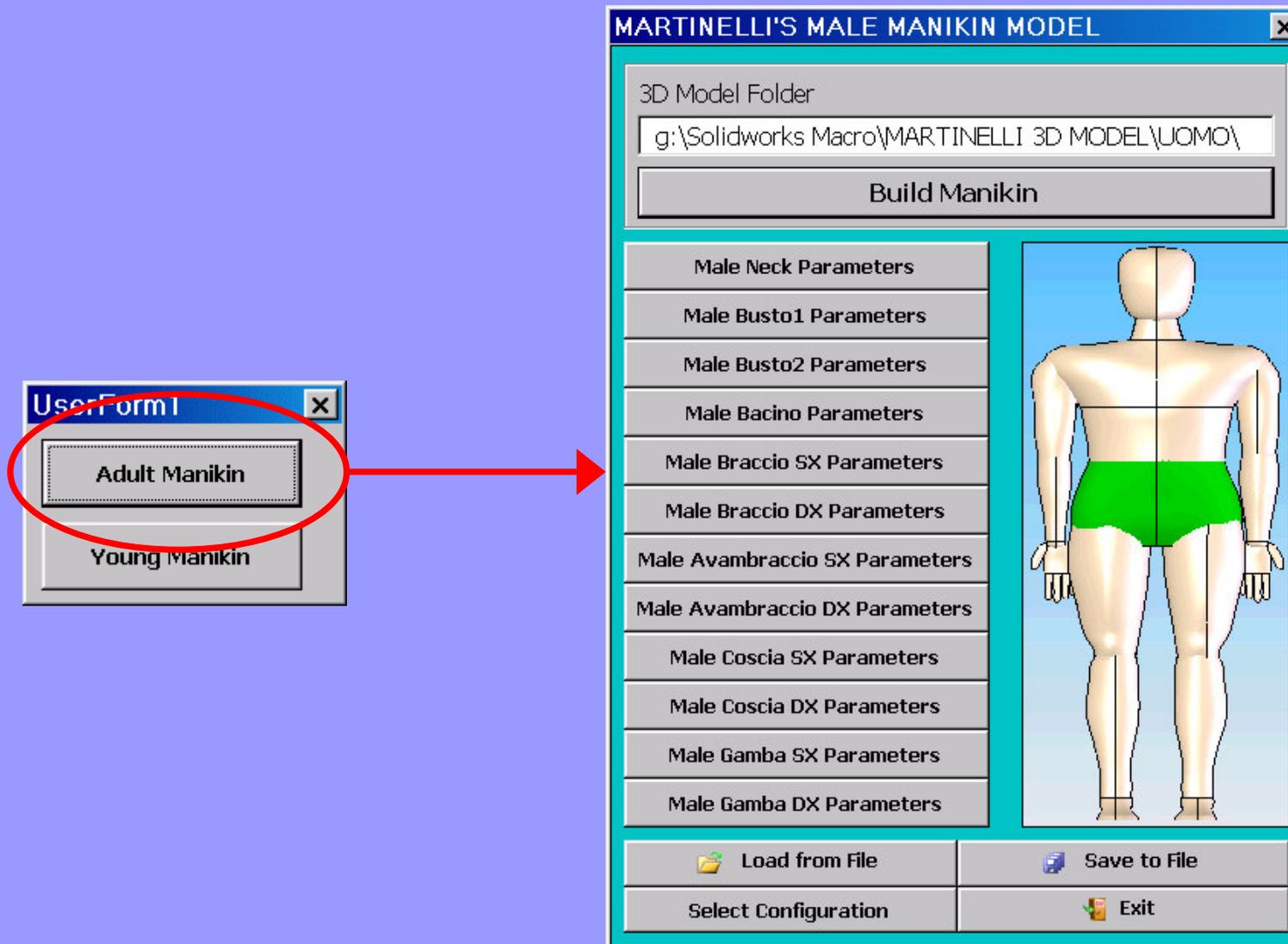


A) Solidworks Add-in: Riferimenti per il nuovo modello

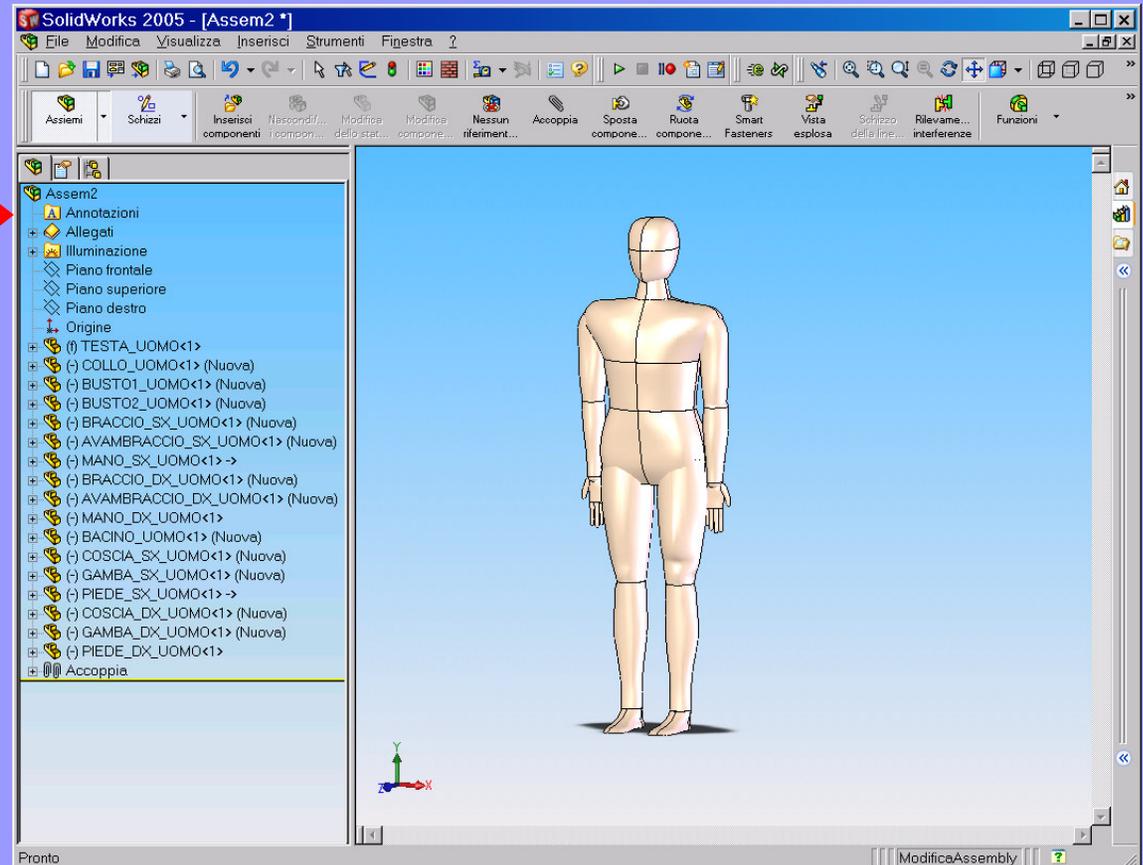
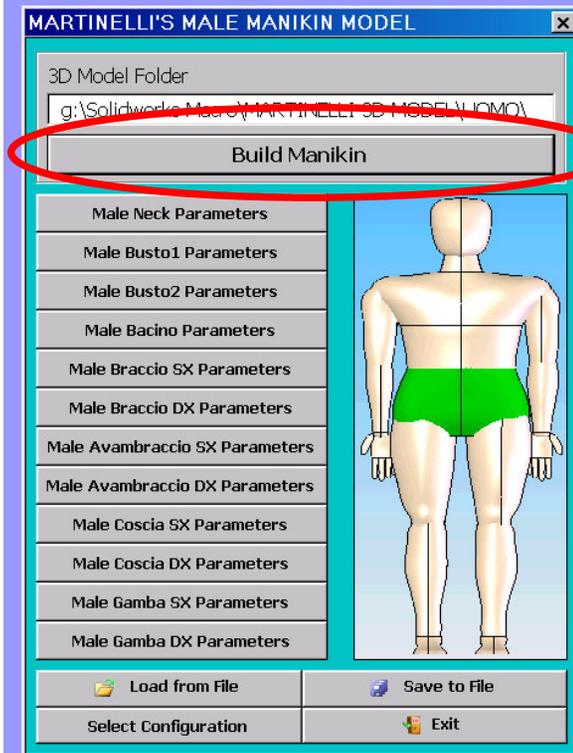
“The Measure of Man & Woman”, Henry Dreyfuss Associates



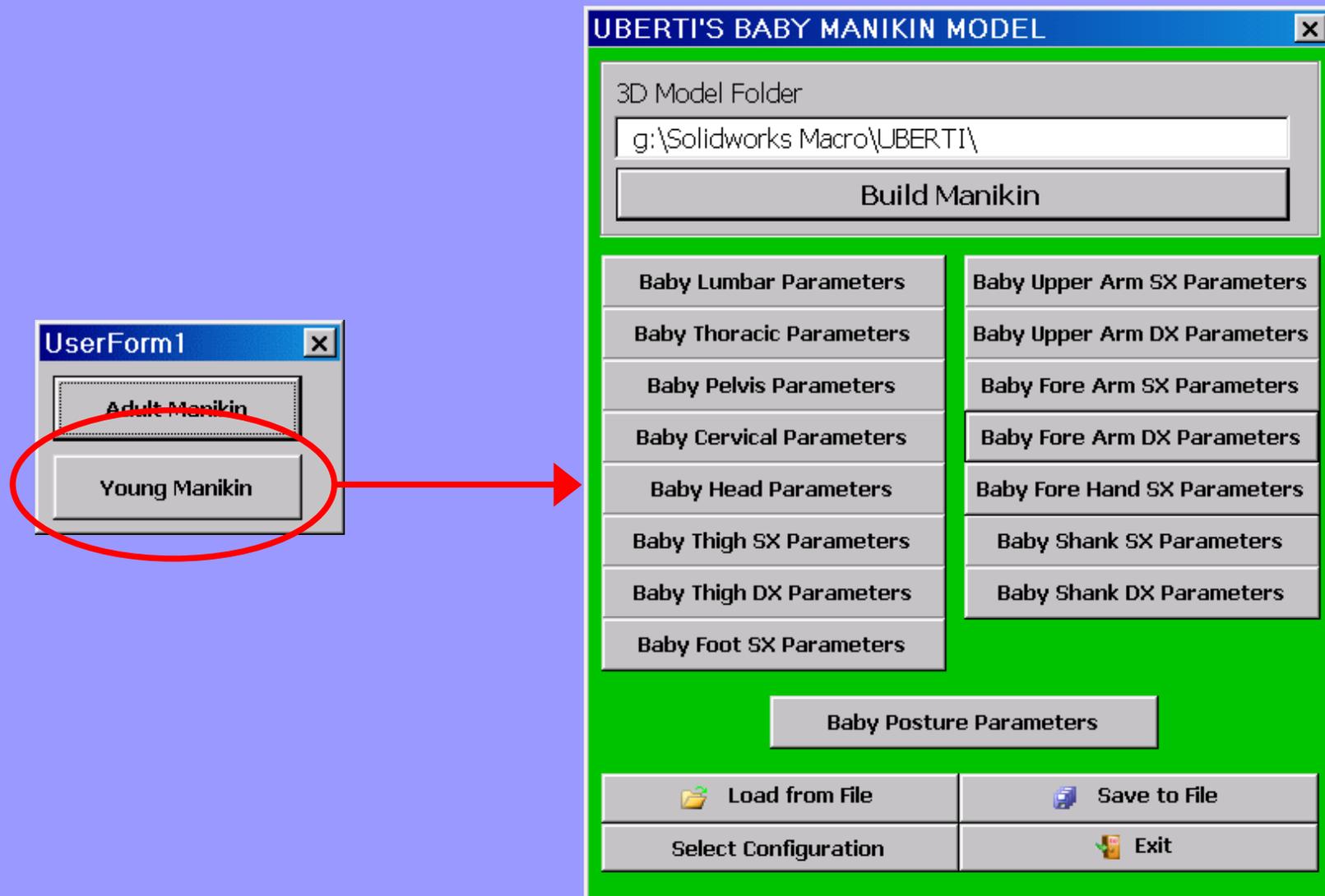
A) Solidworks Add-in: Selezione del modello iniziale



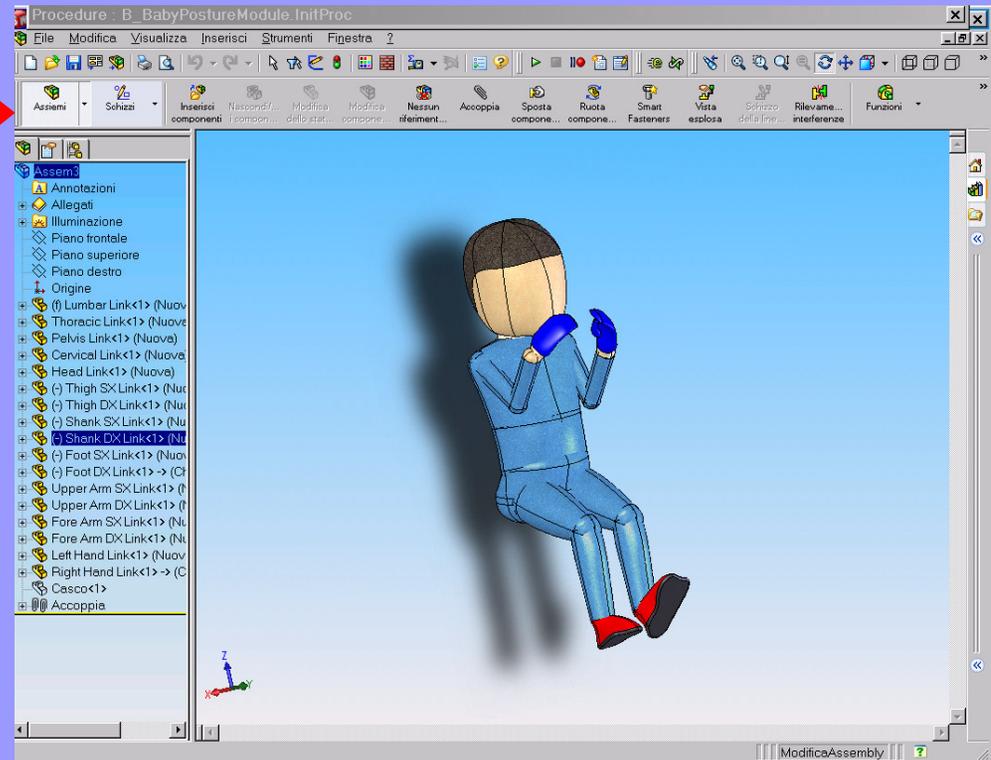
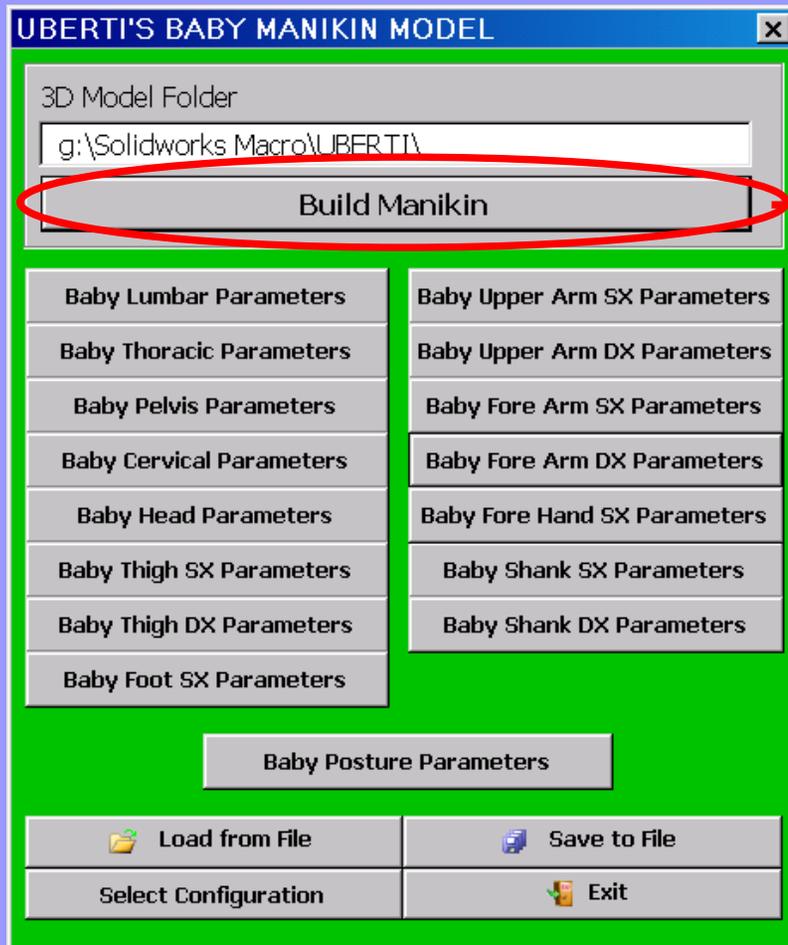
A) Solidworks Add-in: Creazione del modello Iniziale



A) Solidworks Add-in: Selezione del nuovo modello



A) Solidworks Add-in: Nuovo Modello



B) Elaborazione MLKRace: Stato Iniziale

The screenshot displays the MLKRace software interface. The main workspace is divided into three planes: YZ Plane (top left), XZ Plane (top right), and YX Plane (bottom left). The YZ and XZ planes show a 3D model of a suspension system with various components like springs, dampers, and control arms. The YX plane shows a side view of the suspension. The software has a menu bar (File, Tools, Output, Windows) and a toolbar with icons for New, Open, Save, Copy, Draw, Run, Bump, Steer, 3DView, TableB, GraphB, TableS, GraphS, Gra.BS, Anti..., and Pump. The title bar reads "MLKRace - Esempio_BUMP STEER.amu".

On the right side, there is a "Parameters" panel with the following settings:

| Parameter | Value |
|------------------------------------|-------|
| Bump [mm] | 80 |
| Drop [mm] | 60 |
| Wheel Travel StepSize [mm] | 5 |
| Steering ratio [mm/giro] | 35 |
| Steering wheel (lock) angle max[°] | 540 |
| Steering wheel angle step [°] | 15 |
| Bump steer angle [°] | 90 |

Below the parameters panel is a "Tools" section with options: "Save parameters as default" (checked), "Zoom of the geometry" (set to 100), "View static configuration in animation" (unchecked), and a "Double rocker" checkbox (unchecked). There is also a "Geometry" button.

At the bottom, there is a "Settings" panel with three tabs: "Settings", "Suspension Geometry", and "Design Details".

Settings

| | |
|-----------------------|---|
| Axle position | Front |
| Type | <input type="checkbox"/> McPh Double wishbone |
| Configuration | Outboard spring |
| Spring mounting point | To bottom wishbone |

Suspension Geometry

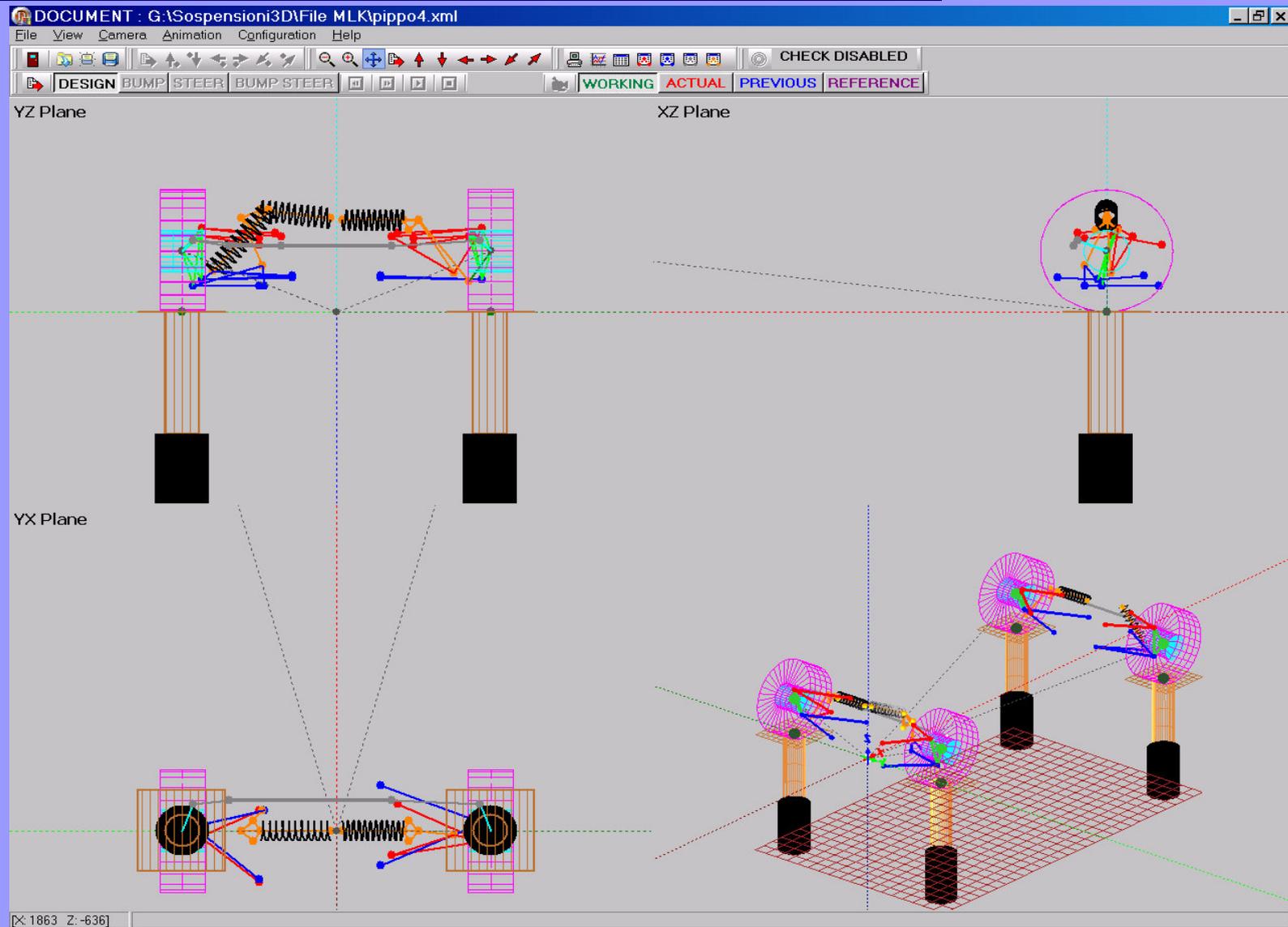
| | |
|-------------------------------|--------|
| Tyre rolling radius - nominal | 250.00 |
| Rim diameter ["] | 13.00 |
| Rim width ["] | 6.50 |
| Rim offset [mm] | 32.00 |
| Aspect ratio | 55.00 |
| Tyre width [mm] | 205.00 |

Design Details

| | |
|-------------------------------|----------|
| Camber [°] | 0.00 |
| Toe in [°] | 0.00 |
| Wheel track - nominal [mm] | 1400.00 |
| Wheel track - computed [mm] | 1400.00 |
| Wheelbase [mm] | 2500.00 |
| Brake position | Outboard |
| Wheel drive | Front |
| Centre of gravity height [mm] | 350.00 |
| Front brake balance [%] | 60.00 |
| Ride height [mm] | 90.00 |

The status bar at the bottom shows the date "18/10/07" and the time "19.33".

B) Elaborazione MLKRace: Nuova Interfaccia



B) Elaborazione MLKRace: Strutture Dati

```
- <car text="ModelloA">
+ <generalData></generalData>
+ <suspension></suspension>
- <suspension>
  <iD>RearRight</iD>
  + <settingData></settingData>
  + <parameterData></parameterData>
  + <tyre></tyre>
  + <topMultiLink></topMultiLink>
  + <bottomMultiLink></bottomMultiLink>
  + <spring></spring>
  + <wheelHub></wheelHub>
  + <piston></piston>
  </suspension>
+ <suspension></suspension>
+ <suspension></suspension>
- <steering>
  <iD>RearSteering</iD>
  <visible>>true</visible>
  + <leftOnWheelPtn></leftOnWheelPtn>
  + <leftOnChassisPtn></leftOnChassisPtn>
  + <rightOnChassisPtn></rightOnChassisPtn>
  + <rightOnWheelPtn></rightOnWheelPtn>
  </steering>
+ <steering></steering>
</car>
```

B) Elaborazione MLKRace: Geometria della Sospensione 1/2

Suspension Configuration

Rear Left | Rear Right | FrontLeft | FrontRight

Chassis Side

| | X | Y | Z |
|-------------------|---------|--------|--------|
| Top Front Link | 100.00 | 350.00 | 360.00 |
| Top Rear Link | -250.00 | 350.00 | 330.00 |
| Bottom Front Link | 100.00 | 330.00 | 130.00 |
| Bottom Rear Link | -240.00 | 350.00 | 130.00 |

Wheel Side

| | X | Y | Z |
|-------------------|--------|--------|--------|
| Top Front Link | -30.00 | 620.00 | 373.00 |
| Top Rear Link | -30.00 | 620.00 | 373.00 |
| Bottom Front Link | 20.00 | 650.00 | 130.00 |
| Bottom Rear Link | 20.00 | 650.00 | 130.00 |

Link Lengths

| | mm |
|---------------------------------------|--------|
| Top Front Link | 299.95 |
| Top Rear Link | 350.93 |
| Bottom Front Link | 329.85 |
| Bottom Rear Link | 396.99 |
| Track Rod | 163.17 |
| (Track Rod - Wheel) Connection | 148.55 |
| Spring Link | 321.50 |
| Chassis Front Top - Bottom PushRod | 130.38 |
| Chassis Rear Top - Bottom PushRod | 364.14 |
| Chassis Front Bottom - Bottom PushRod | 100.50 |
| Chassis Rear Bottom - Bottom PushRod | 354.54 |
| Wheel Front Top - Bottom PushRod | 340.22 |
| Wheel Rear Top - Bottom PushRod | 340.22 |
| Wheel Front Bottom - Bottom PushRod | 335.41 |
| Wheel Rear Bottom - Bottom PushRod | 335.41 |
| PushRod Link | 268.19 |
| Rocker Link | 100.00 |

Link Angles

| | MultiLink Angle ° |
|---------------------------------------|-------------------|
| Top Front Angle - Chassis Side [°] | 64.651 |
| Top Front Angle - Wheel Side [°] | 64.775 |
| Top Rear Angle - Chassis Side [°] | 50.574 |
| Top Rear Angle - Wheel Side [°] | 64.775 |
| Bottom Front Angle - Chassis Side [°] | 72.597 |
| Bottom Front Angle - Wheel Side [°] | NAN |
| Bottom Rear Angle - Chassis Side [°] | 52.452 |
| Bottom Rear Angle - Wheel Side [°] | NAN |
| TrackRod - Join To Wheel [°] | 112.584 |

Chassis Side

| | X | Y | Z |
|-----------|--------|--------|--------|
| Track Rod | 150.00 | 490.00 | 325.00 |

Wheel Side

| | X | Y | Z |
|-----------|--------|--------|--------|
| Track Rod | 130.00 | 650.00 | 350.00 |

Chassis Side

| | X | Y | Z |
|-------------|------|--------|--------|
| Abs. Spring | 0.00 | 29.00 | 460.00 |
| PushRod | 0.00 | 435.00 | 460.00 |

Wheel Side

| | X | Y | Z |
|--------------|--------|--------|--------|
| Abs. Spring | 0.00 | 348.00 | 500.00 |
| Abs. PushRod | 100.00 | 340.00 | 230.00 |
| Rel. PushRod | 0.00 | 0.00 | 0.00 |

Pivot 1

| | X | Y | Z |
|--------|-------|--------|--------|
| Rocker | 50.00 | 378.00 | 400.00 |

Pivot 2

| | X | Y | Z |
|--------|--------|--------|--------|
| Rocker | -50.00 | 378.00 | 400.00 |

B) Elaborazione MLKRace: Geometria della Sospensione 2/2

Setting Suspension

Rear Left | **Rear Right** | FrontLeft | FrontRight

Type McPh

Configuration

Pushrod Mounting Point

Tyre Rolling Radius [mm]

Rim Diameter ["]

Rim Width ["]

Rim Offset [mm]

Aspect Ratio

Tyre Width [mm]

Brake Position

Wheel Drive

Center of Gravity Height [mm]

Front Brake Balance [%]

Ride Height [mm]

Initial Camber [°]

Initial Toe In [°]

Camber - Computed [°]

Toe In - Computed [°]

Wheel Track - Nominal [mm]

Wheel Track - Computed [mm]

Wheelbase - Nominal [mm]

Wheelbase - Computed [mm]

Piston Height [mm]

B) Elaborazione MLKRace: Parametri di elaborazione

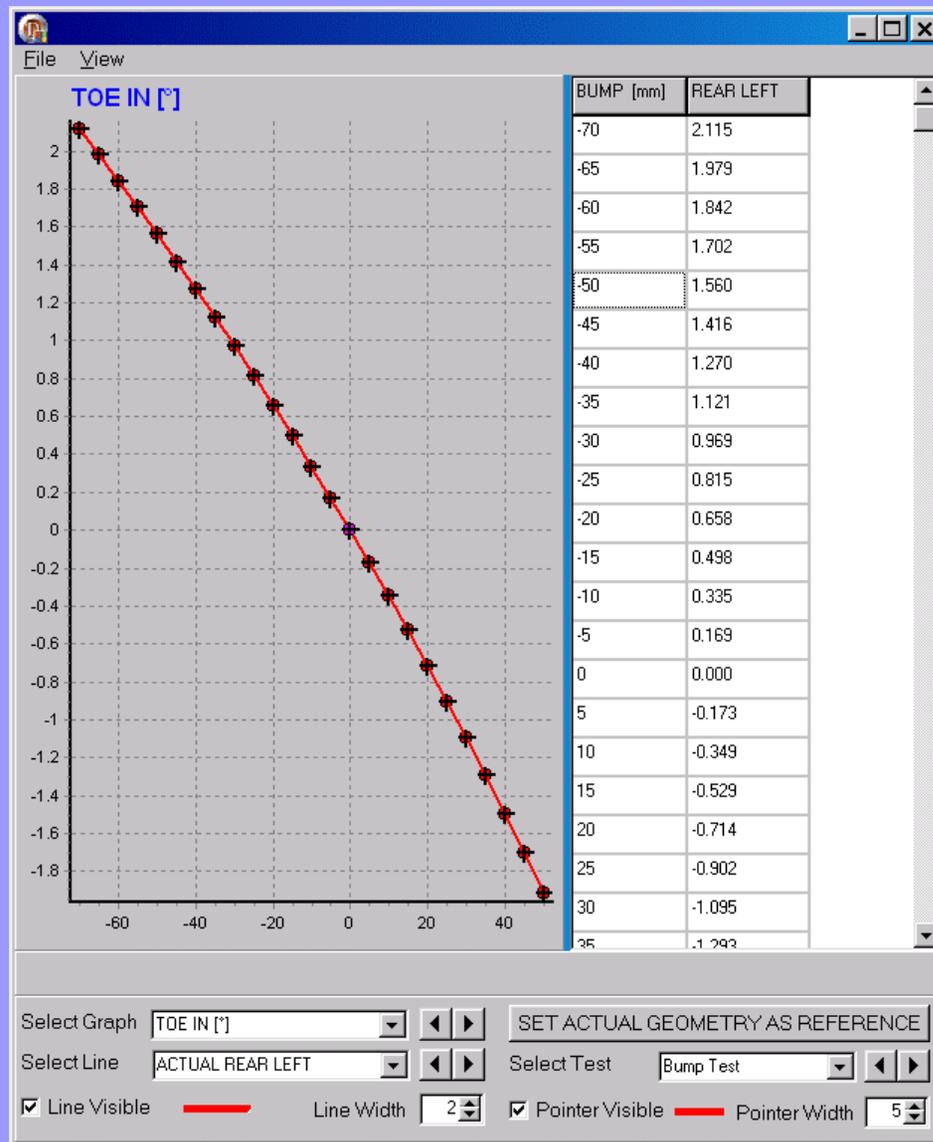
Suspension Configuration [X]

Rear Left | Rear Right | FrontLeft | FrontRight

| | |
|---|---------|
| Bump Max Value [mm] | 50.00 |
| Bump Min Value [mm] | -70.00 |
| Bump Increment Step Value [mm] | 5.00 |
| Bump Actual Value [mm] | 0 |
| Bump Manual Increment Step Value [mm] | 1.00 |
| Steering Max Value [°] | 360.00 |
| Steering Min Value [°] | -360.00 |
| Steering Increment Step Value [°] | 15.00 |
| Steering Actual Value [°] | 0 |
| Steering Manual Increment Step Value [mm] | 1.00 |
| Steering Ratio Value [mm/giro] | 60.00 |
| Bump Steer Max Angle [°] | 90.00 |
| Bump Steer Min Angle [°] | 0.00 |

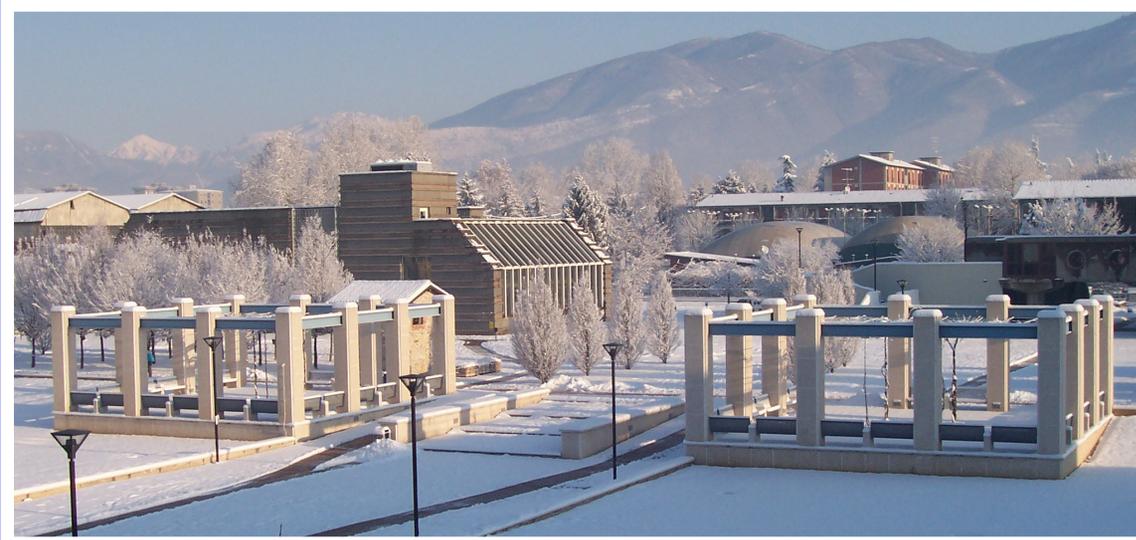
Apply Cancel Help Exit

B) Elaborazione MLKRace: Grafici dei risultati



C) Corsi di formazione in B&R automation

- **MOTIVAZIONE:** Entrare in contatto con una delle principali aziende nel settore dell'automazione industriale.
- **CORSI FREQUENTATI:**
 1. **Ambiente di sviluppo: Automation Studio**
 2. **Visual Component: tool integrato per la realizzazione di scada**
 3. **Motion: modulo per la gestione della movimentazione dei motori (CNC, camme...)**



... grazie

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Valerio Manenti
Relazione di Dottorato 3° anno

20/20