



# Comparison of Gradient Search with Genetic Algorithms for Nose Landing Gear



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**Ever wonder...?!?**




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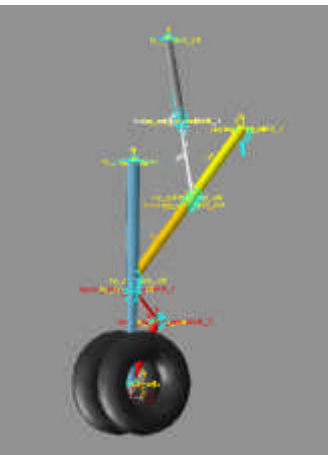
## Which is Best for Landing Gear Optimization : Genetic Algorithms or Gradient Search?

- Optimize geometric layout
- Maximize retraction efficiency
  - ◆ used in actuator sizing
  - ◆ ensures constant demand on hydraulic system during actuation
- Optimization constraints to ensure full retraction and avoid lockup conditions




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## Nose Landing Gear for Optimization



- Conventional aft-deploying (forward retracting) nose gear with collapsing brace
- Rigid Model only
- Design Variables:
  - ◆ 20 geometric layout variables
  - ◆  $P1(x,y) \rightarrow P10(x,y)$



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## Retraction Efficiency Function

$$|\max(F_R) \cdot z_{\max}| - \int_{z_0}^{z_{\max}} F_R(z) \cdot dz$$

Where


$F_R$  ~ retraction force  
 $z$  ~ retraction position

Rewritten as time function:

$$|\max(F_R) \cdot z_{\max}| - \int_{t_0}^{t_{\max}} F_R(z) \cdot \dot{z} dt$$

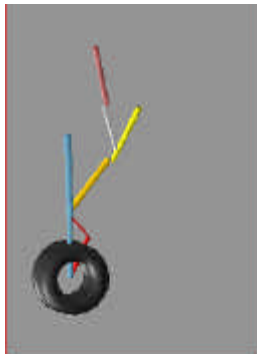
Solver and View language:

- View fun = (MAX{(Last\_Run.MOT1.FZ.values)} \* (MAX{Last\_Run.DZ.values}) - LAST(.nosegear.DIFF\_1))
- DIFF\_1=MOTION(.nosegear.MOT1, 0, 1, 0)  
 \*VZ(.nosegear.lower\_retraction.MAR507, .nosegear.upper\_retraction.MAR407)

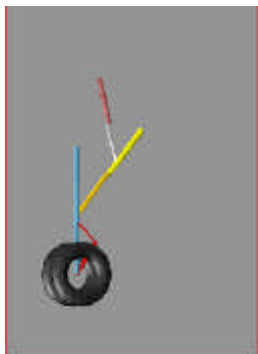


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## Initial Results Show Different Optimums Found through Different Searches



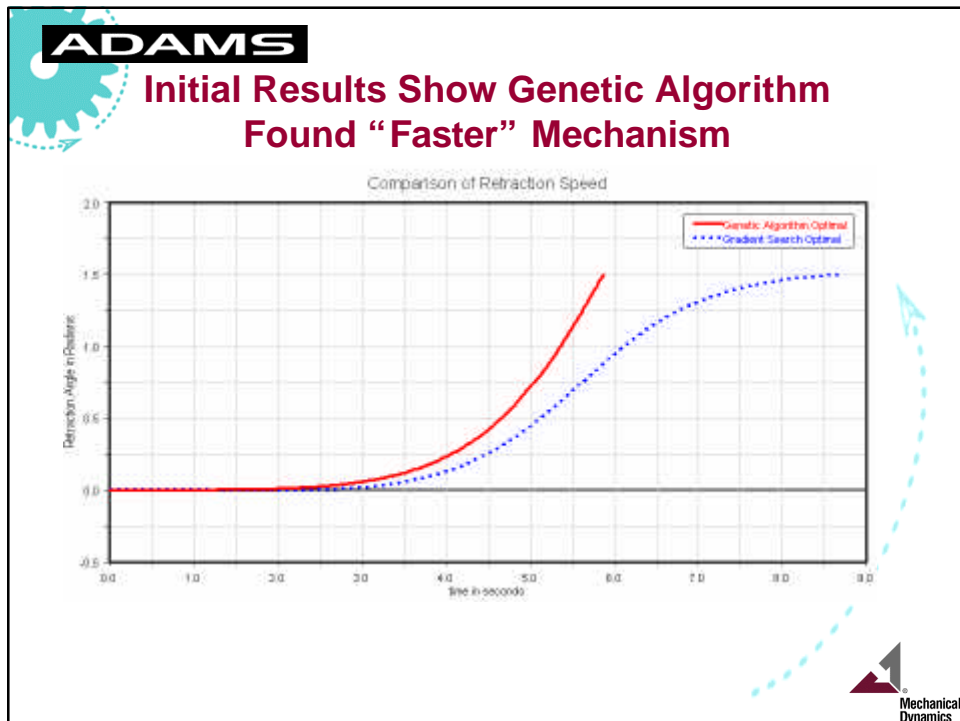
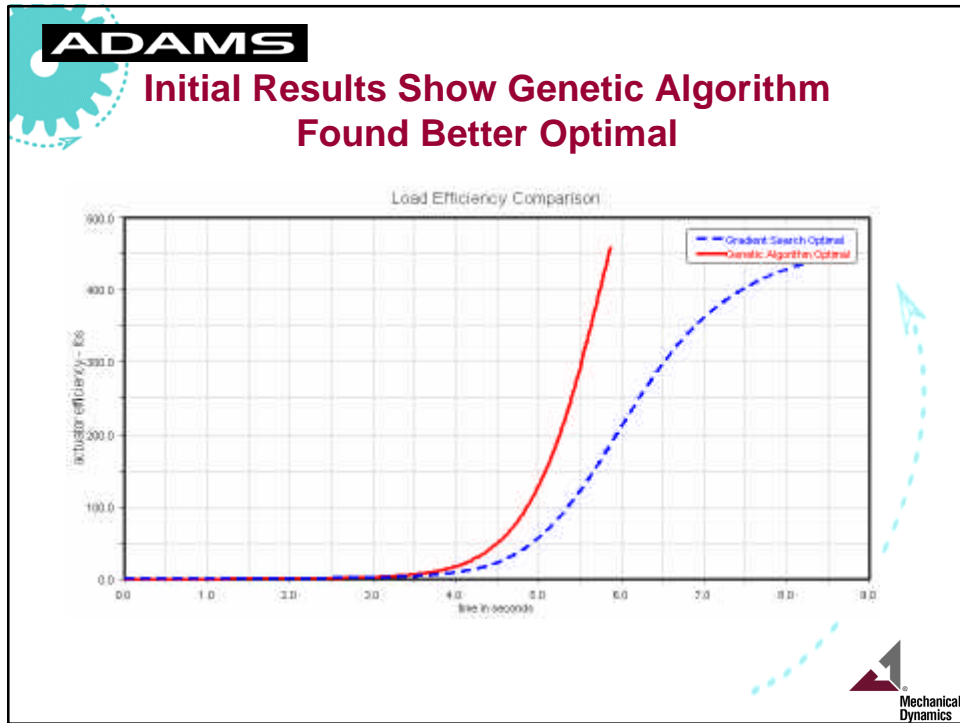
Gradient Search Optimization




Genetic Algorithm Optimization



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## Conclusions for Landing Gear Problem

- ADAMS architecture allows easy comparison between design study and optimization methods
- Gradient search found local optimal, global optimal not known but *genetic algorithm found better solution*
- Hydraulic system effects being added to understand effect on optimal
- Main gear (nonplanar) mechanism being explored for effects of more complex layouts

