



Robotized Variable Geometry Wheel (R-VGW) 变形机械几何轮

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Wheel History 历史车轮



Left-right : 3 tripartite wheels 3500 BC-early 19th century; war chariot wheel BC 2500 (Louvre Museum); Greek wheel 600 BC (National Museum of Athens).
由左至右：西元前三千五百年到十九世紀初的車輛；西元前二千五百年的戰車（羅浮宮）；西元前六百年希臘車輛（雅典國立博物館）

Motivation 动机

- Mathematics theme of this academic year :

Mathematics transport us

今年数学学术主题：数学與运输

- Movement of people with disabilities.

改善残疾人士的行动

- Transport problems (economic, ecologic, technical & social) 交通问题

- Stagnation of space rover *Spirit*, in the sands of Mars, and its abandonment by NASA after several rescue attempts. 火星探測站車 Spirit 在沙滩滞留，美国 NASA 在几次救援尝试后放弃

Some wheel models related to our project

与我们研究相關的一些車轮机型

Idea 主意

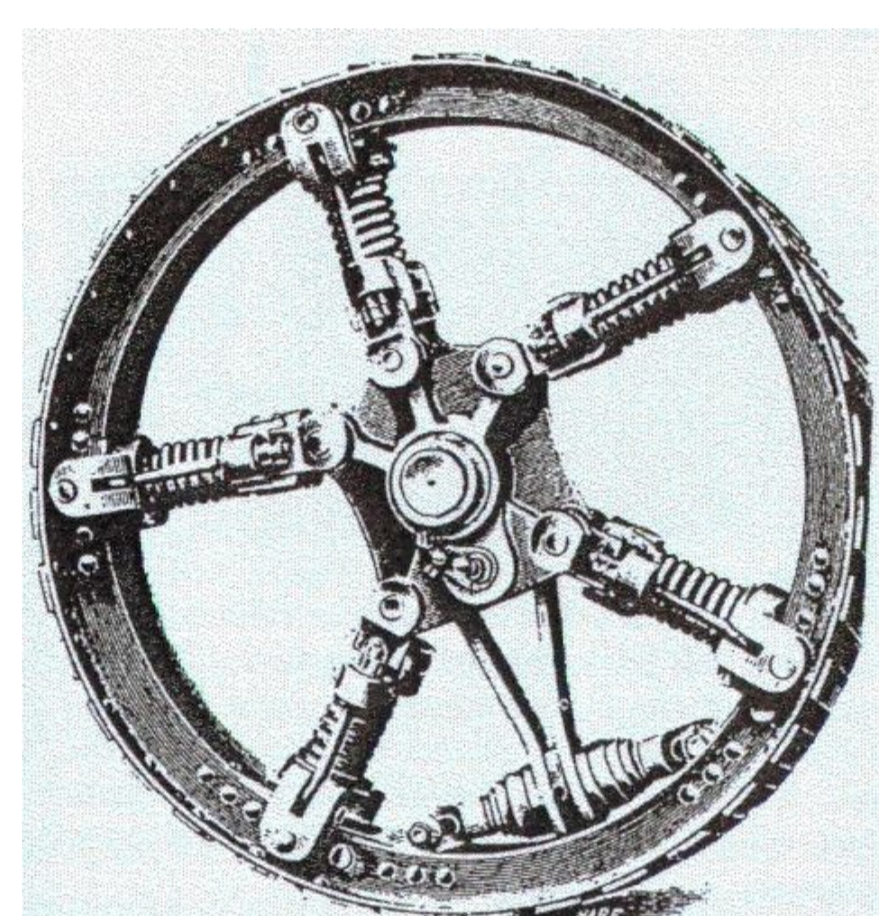
- A project linking geometry and transportation
研究串連几何和运输

→ Polygonal wheels 多边形轮

- Eventual economical and environmental advantages and disadvantages. 最终的经济和环境优势和劣势

- A wheel combining several geometric shapes.
车轮由多个几何形状組成

→ A deformable wheel through programmable actuators. 通过可编程的驱动器可变形的车轮。



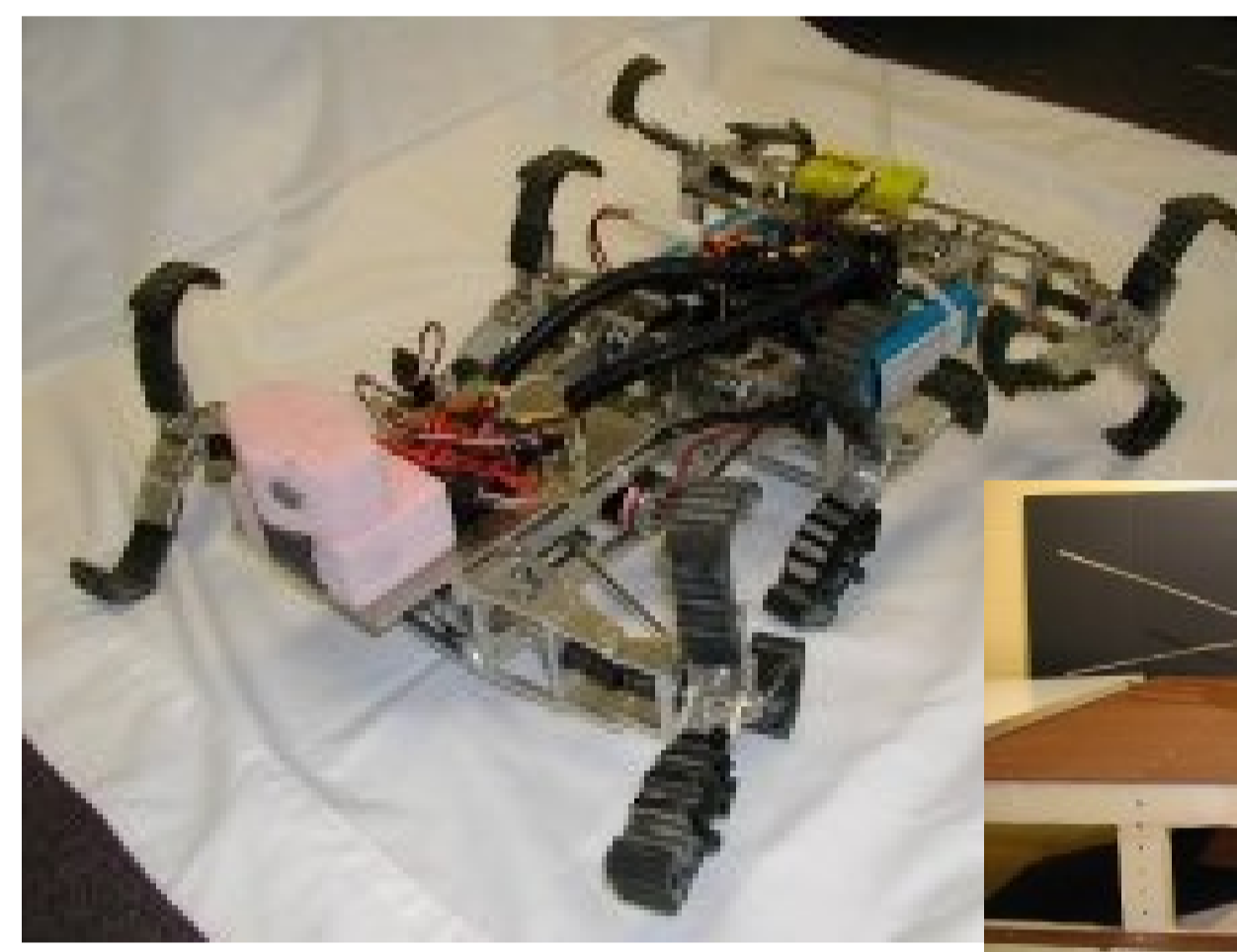
Fowler wheel 1870 for steam tractors

弹簧变形轮蒸汽拖拉机



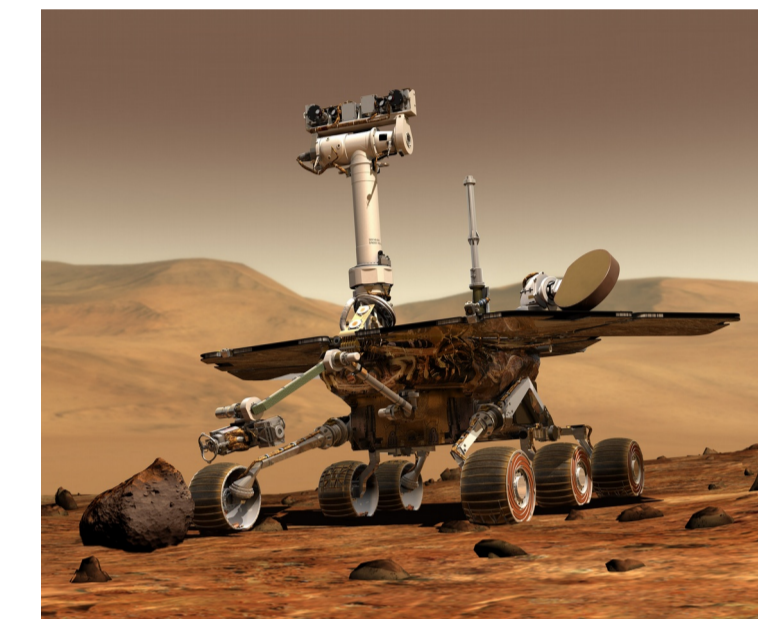
Whigs (Wheels and legs) Biorobots: 1st & 2nd generations inspired by the cockroach locomotion Case Western Reserve University, Ohio

车轮和腿机器人生物灵感蟑螂运动



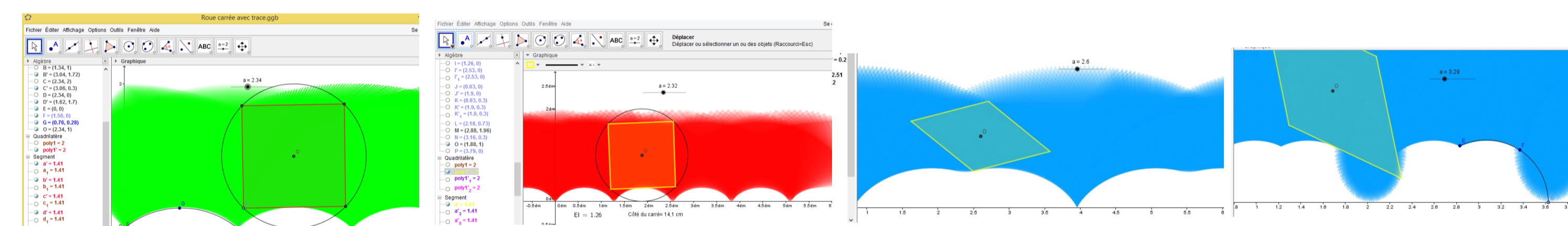
Spiral springs wheel used by NASA on its rovers Spirit and Opportunity in 2004

它的空间探测器用于 NASA 轮



Wheels of the rover Axel, NASA 2011

Modeling polygonal wheels movement with Geogebra software 多边形建模车轮运动与 Geogebra 软件

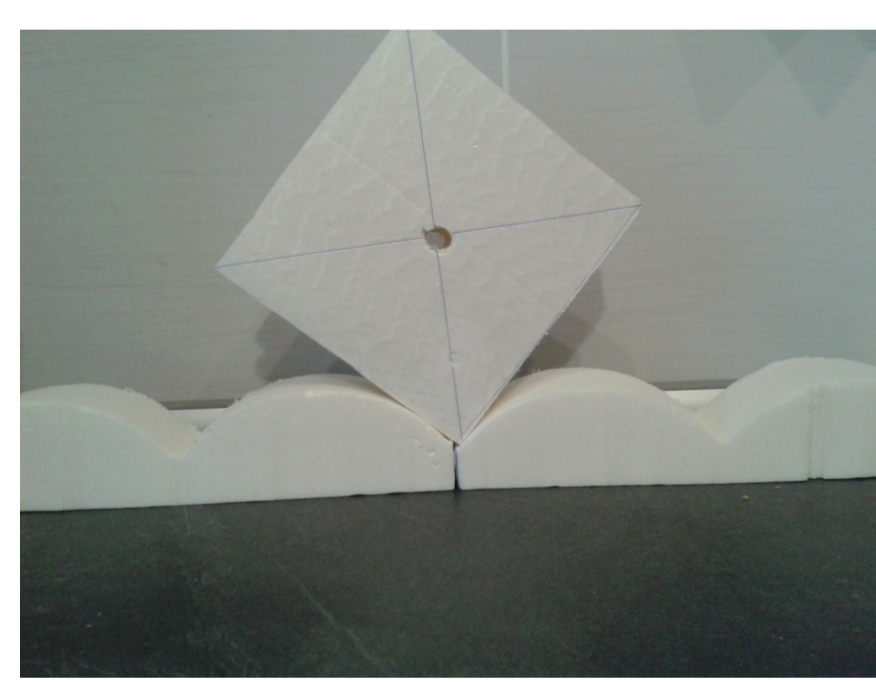
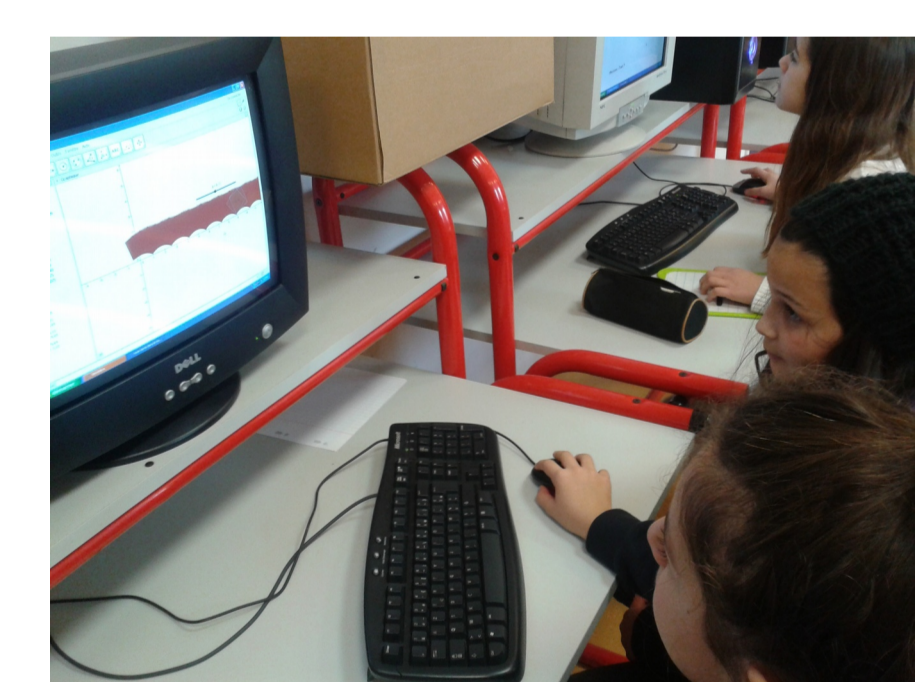


Not optimized
不优化

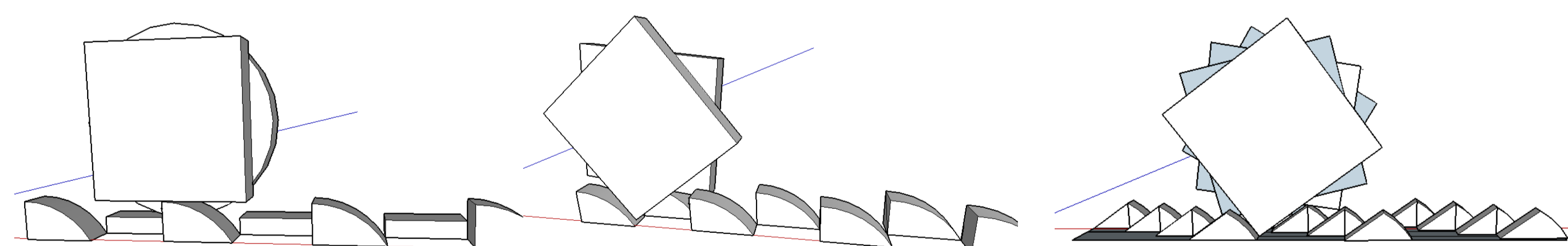
Optimized
优化

Not optimized
不优化

Optimized
优化



Towards energy saving wheels 对节能轮



Double-body wheel 双体轮

Square-disc 45° twisted squares
方盘 45° 扭曲的正方形

Quad-body wheel 四体轮

22,5°twisted four squares
22.5° 扭曲的四个正方形

The project's students: 参加研究的学生

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Some bibliographical references: 一些书目参考

- http://www.musee-charroi-rural-salmiech.fr/?page_id=92
- Les véhicules tout terrain hors normes 非凡的全地形车 (Internet) <http://www.stanwagon.com/> - <http://www.wikipedia.fr>
- http://www.constructiondepyramides.fr/fr_html/fr_berceaux.htm

Deformable wheel through linear actuators 通过直线执行器变形轮

Advantages 优势

- Changing from circular to elliptical or caterpillar shapes to avoid sliding and skating.
由圆形改为椭圆形或毛毛虫形状为了避免滑动和滑冰

- Self driving 自驾车

- Absorbing shocks if equipped with hydraulic actuators 吸收冲击

- Can be used on a wheelchair to
轮椅可以使用

* Adjust its level

调整其水平

* Take less space for chair's storage

减少椅子所占空间

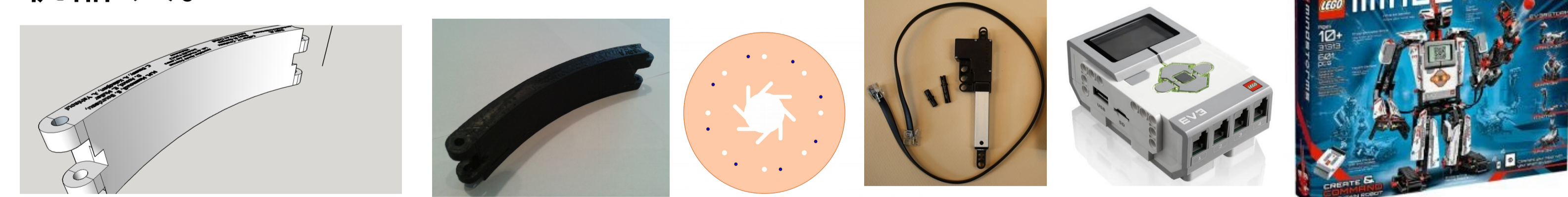
* Cross small obstacles

跨越低障碍

Material used 使用的材料

Computers, Modelling softwares, 3D printers, actuators and Lego Mindstorms EV3 robots.

计算机, 建模软件, 3D 打印机, 傳動裝置和 LEGO MINDSTORMS EV3 机器人。



Other wheel variants 轮的其它变体



Whigs I's configuration
Advantage: variable radius length following the obstacle height.
因應障礙改变半径

Whigs II's configuration
Advantage: variable radius length. It may serves as gripping & digging (s'accrocher et creuser)
挂钩登山

Axel rover's wheel config.
Advantage: deformable, gripping & digging (s'accrocher et creuser)
变形, 握持和挖掘

In parallel, we developed some artistic work related to our project (see the other posters or ask us) 我们还开发了与我们的研究相關的一些艺术作品