



# KITEPOWER

\* a product developer's approach

Reinhart Paelinck

*Airborne Wind Energy Conference,  
September 29, 2010*

## 2 TOPICS

\*MSc thesis: 'Kitepower'

Prof. Moritz Diehl, *KULeuven*  
Johan Neyrinck, *Artesis*

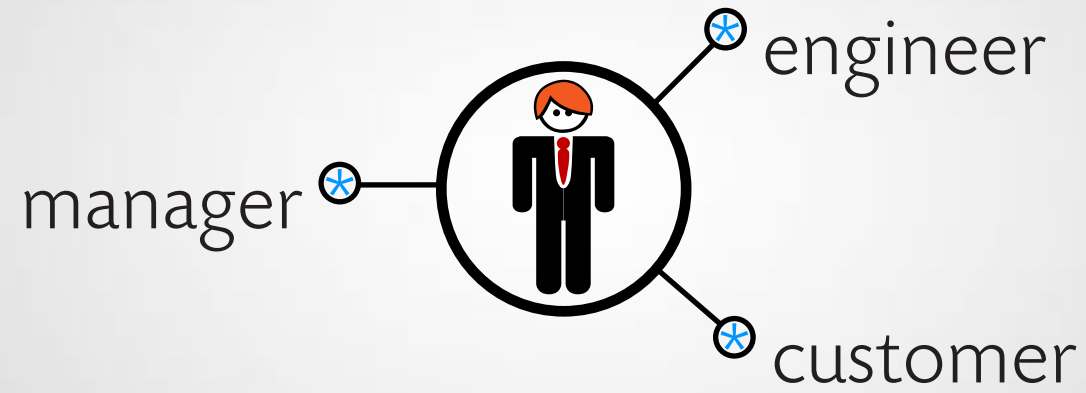


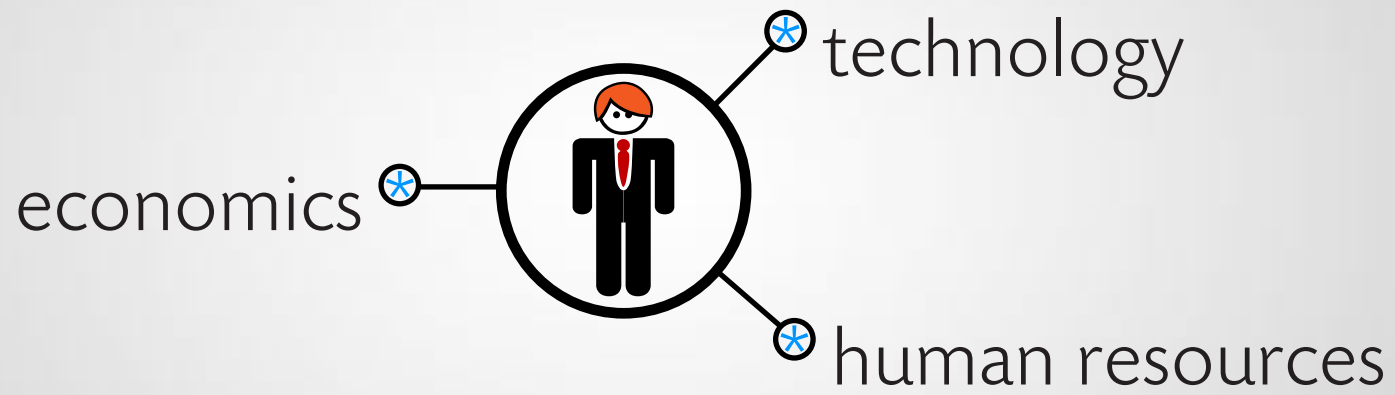
\*PhD thesis: 'Balanced Kites'

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Dr. Karine Van Doorselaer, *Artesis*

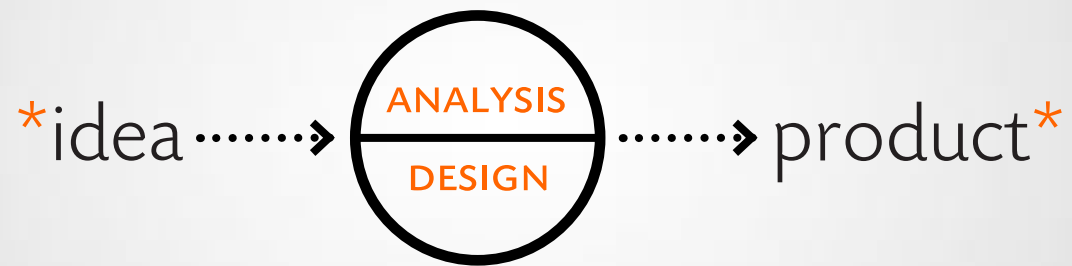


product developer

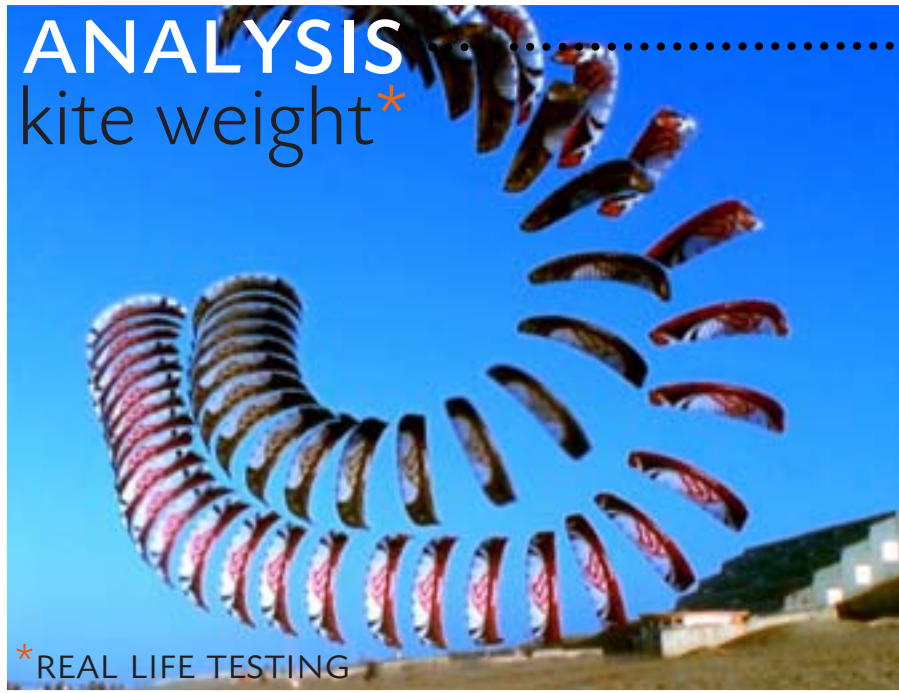








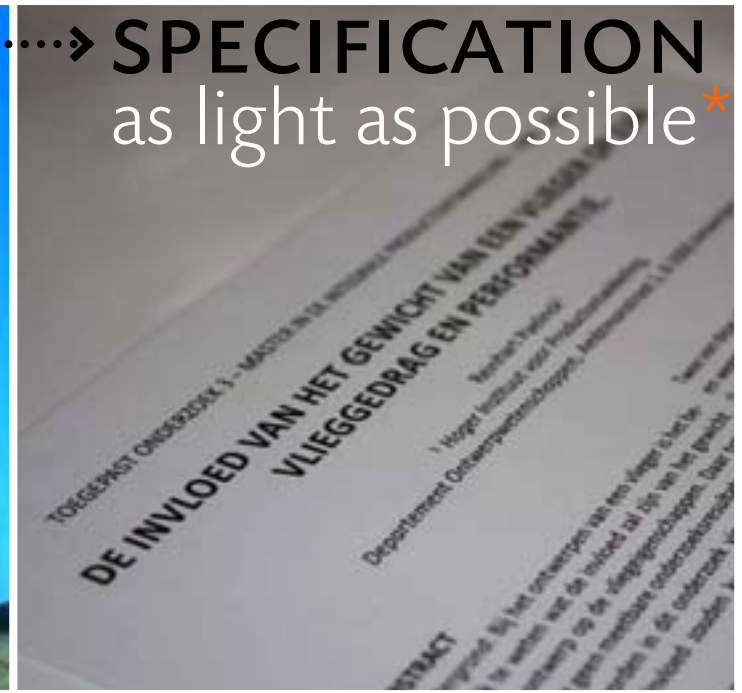
**ANALYSIS**  
kite weight\*



\* REAL LIFE TESTING

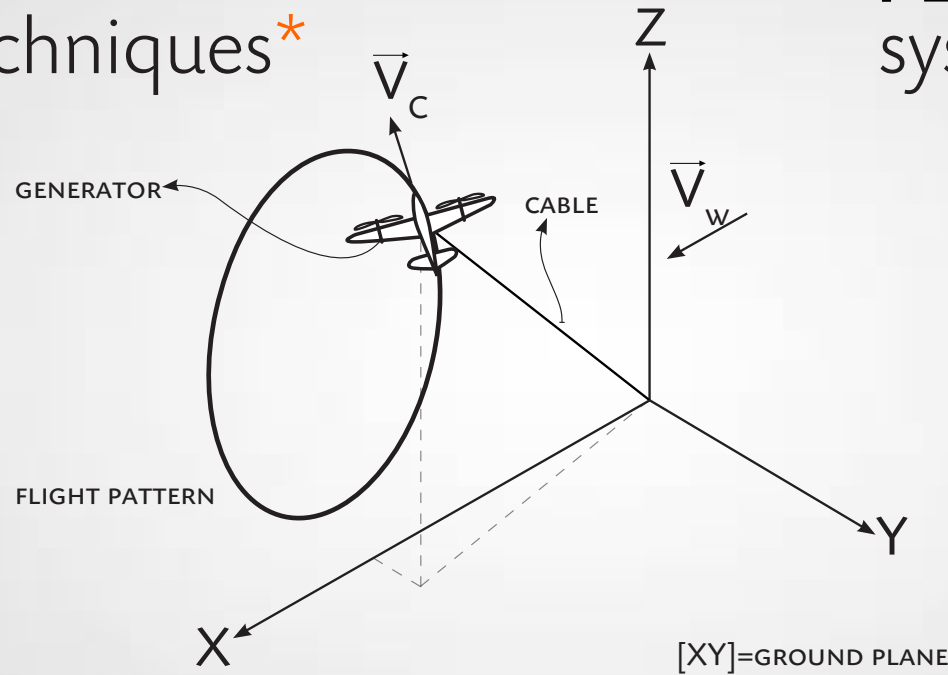


→ **SPECIFICATION**  
as light as possible\*



**ANALYSIS** .....  
functions & techniques\*

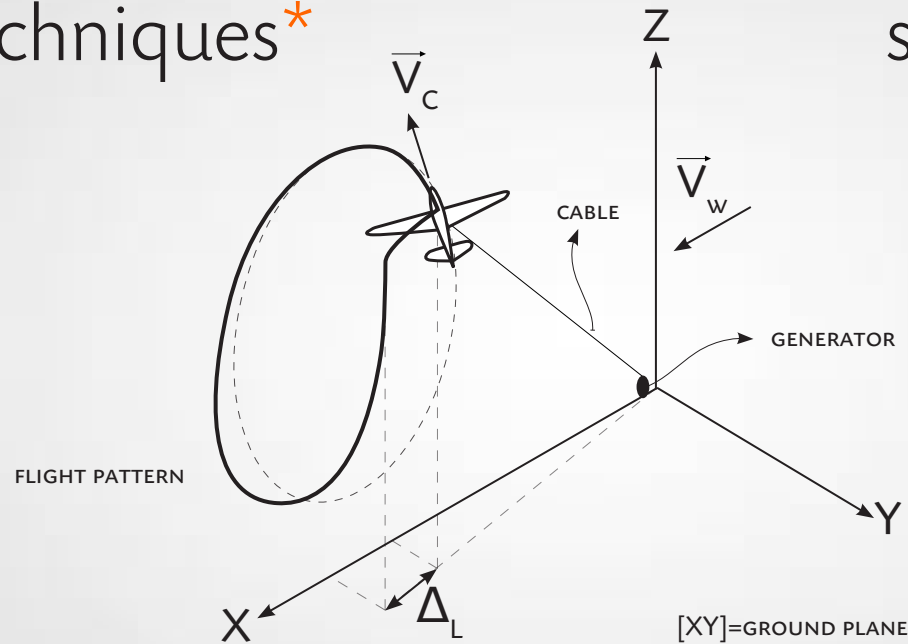
→ **FEATURES**  
systems & components\*



\*MILES LOYD

**ANALYSIS** .....  
functions & techniques\*

→ **FEATURES**  
systems & components\*



- \* KITE
- \* DEPOWER & STEERING
- \* LAUNCHING & LANDING
- \* POWER GENERATION

**FEATURES** .....→ (non)-critical.....→ **DESIGN**

critical = the development of other items depends on the design of the feature

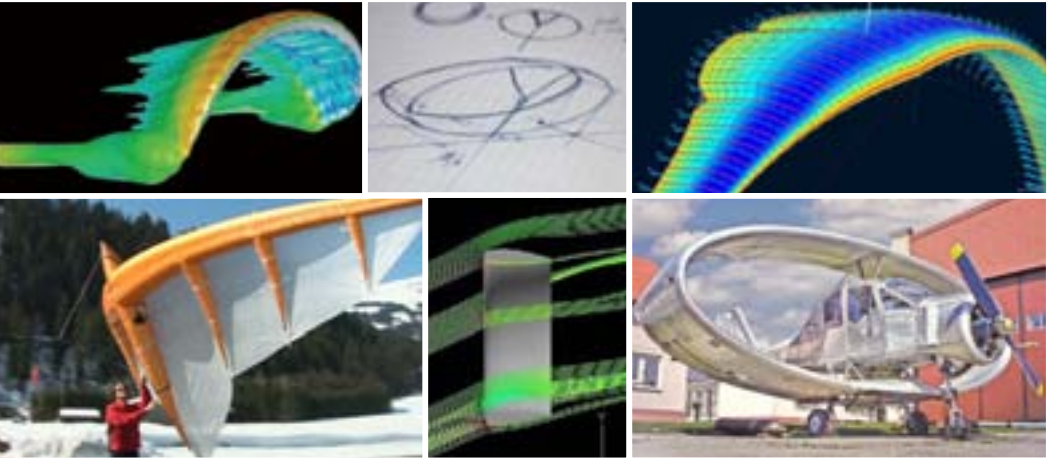
**CRITICAL** →

wing type > depower ⅇ steering  
> launching ⅇ landing  
power generation

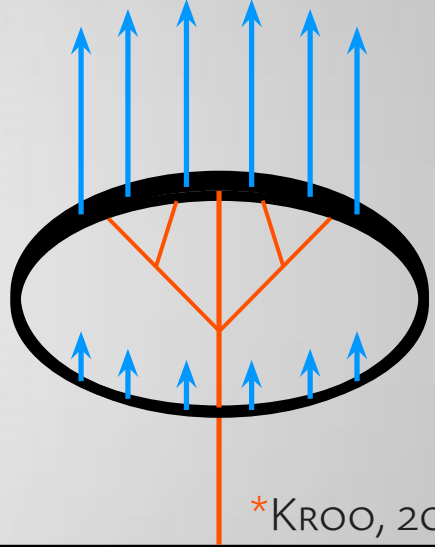
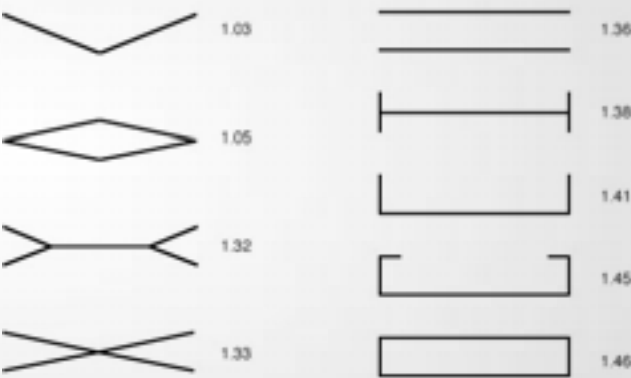
**LESS CRITICAL** →

> ground station | >

# SYSTEM DESIGN



Span Efficiency of Various Nonplanar Shapes  
Height / Span = 0.2

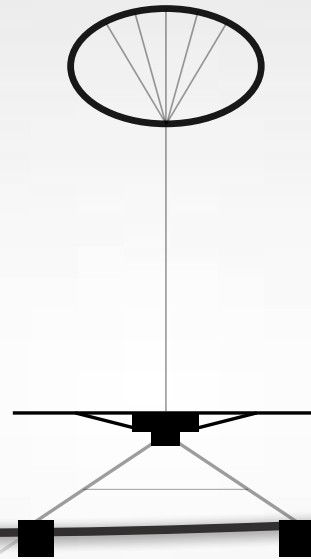


\*KROO, 2005

# SYSTEM DESIGN

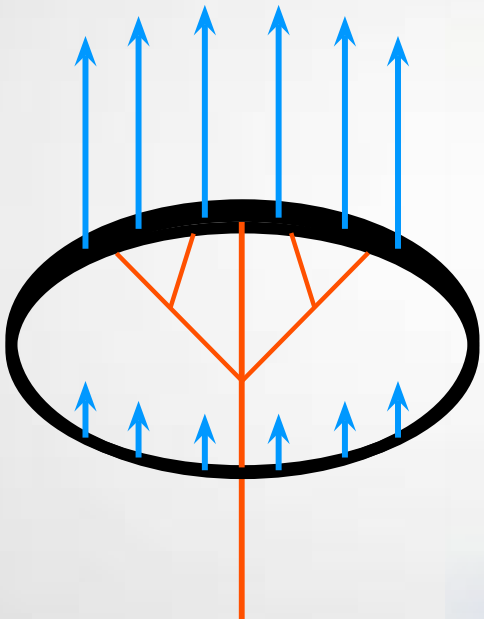


# CONCEPT DESIGN

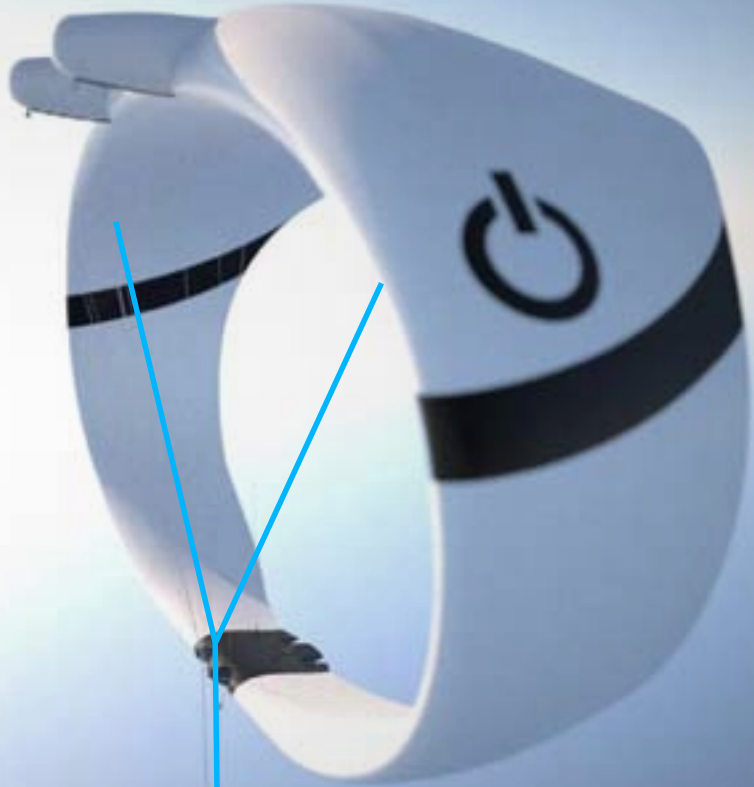


- \* KITE DESIGN
- \* LAUNCH & LANDING
- \* POWER GENERATION
- \* FLOTATION

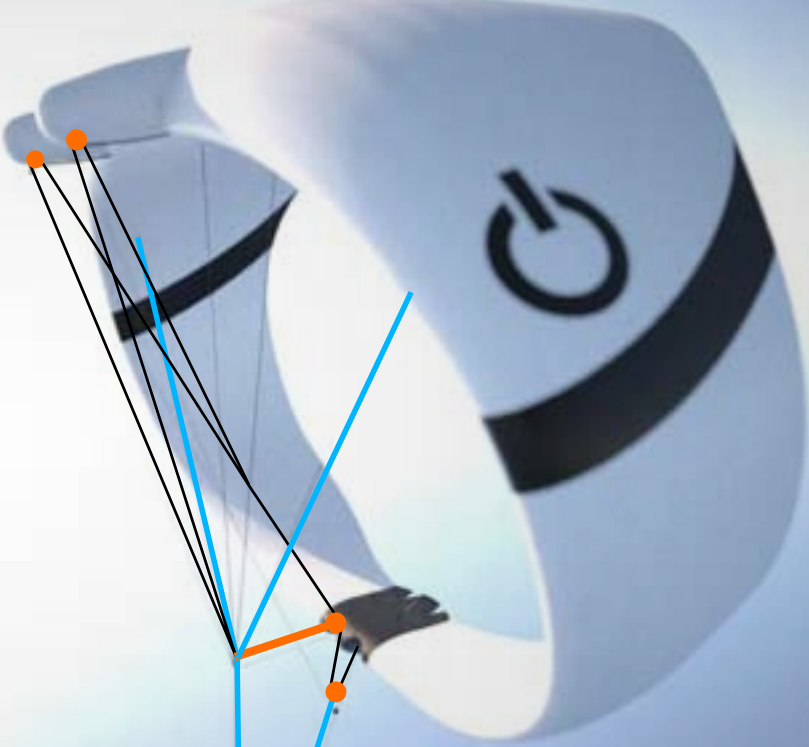
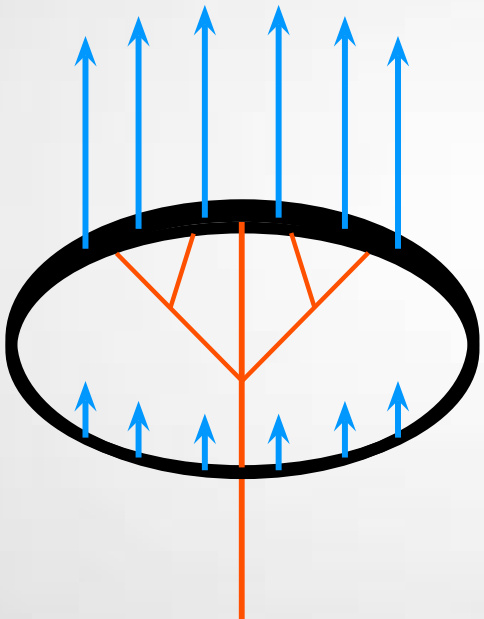
\*kite, 250m<sup>2</sup>



\*ANNULAR WING SHAPE  
LIMITING WINGSPAN, STRENGTH

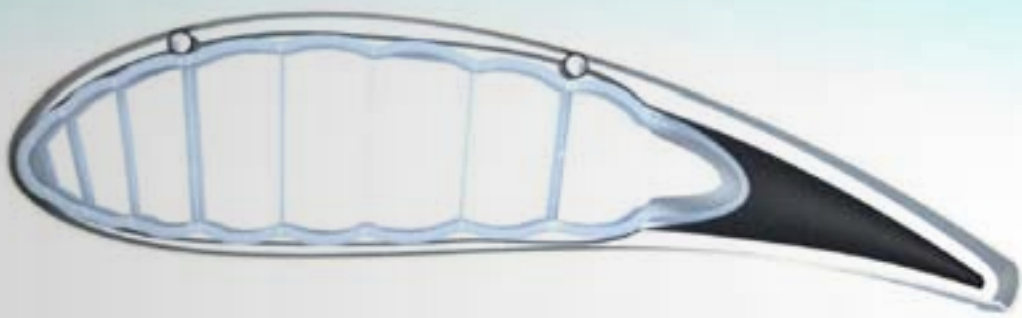


\*kite, 250m<sup>2</sup>



|\*AoA DEPOWER  
LIMITING EXTRA WEIGHT

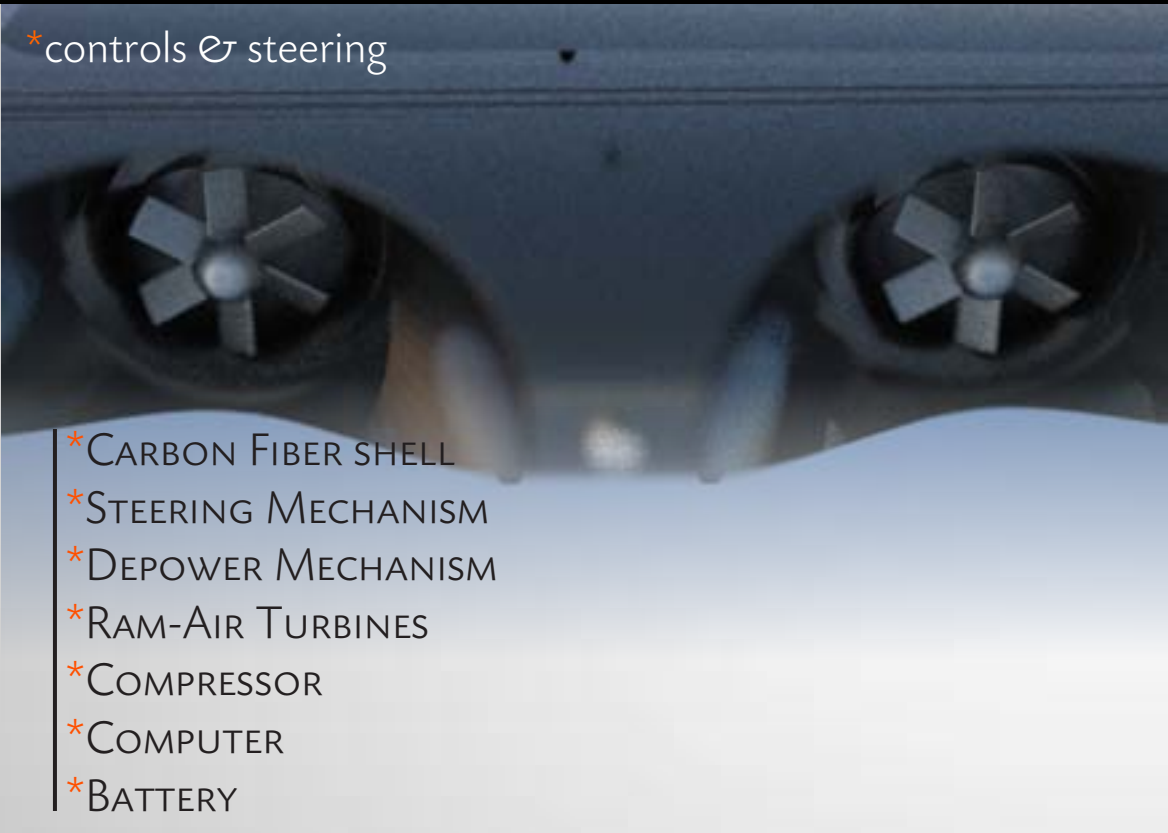
\*kite, 250m<sup>2</sup>



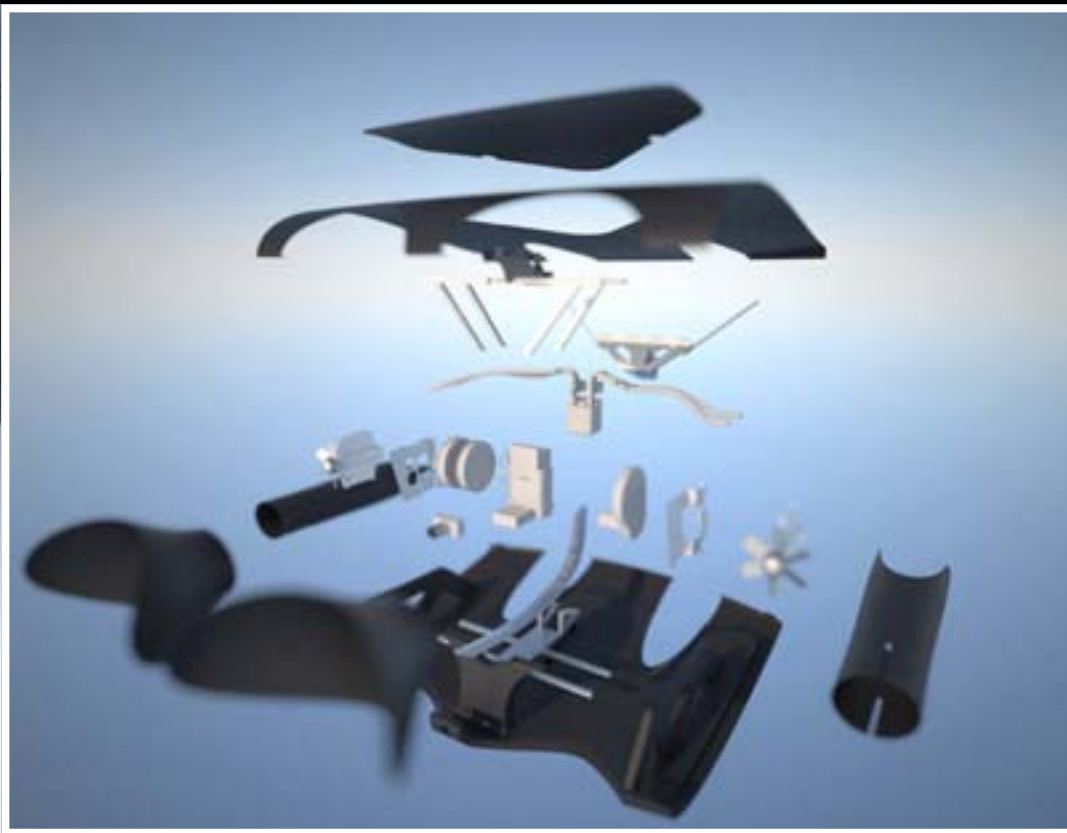
|\*TENSAIRITY CONSTRUCTION  
FLEXIBILITY WHERE NEEDED



\*controls & steering

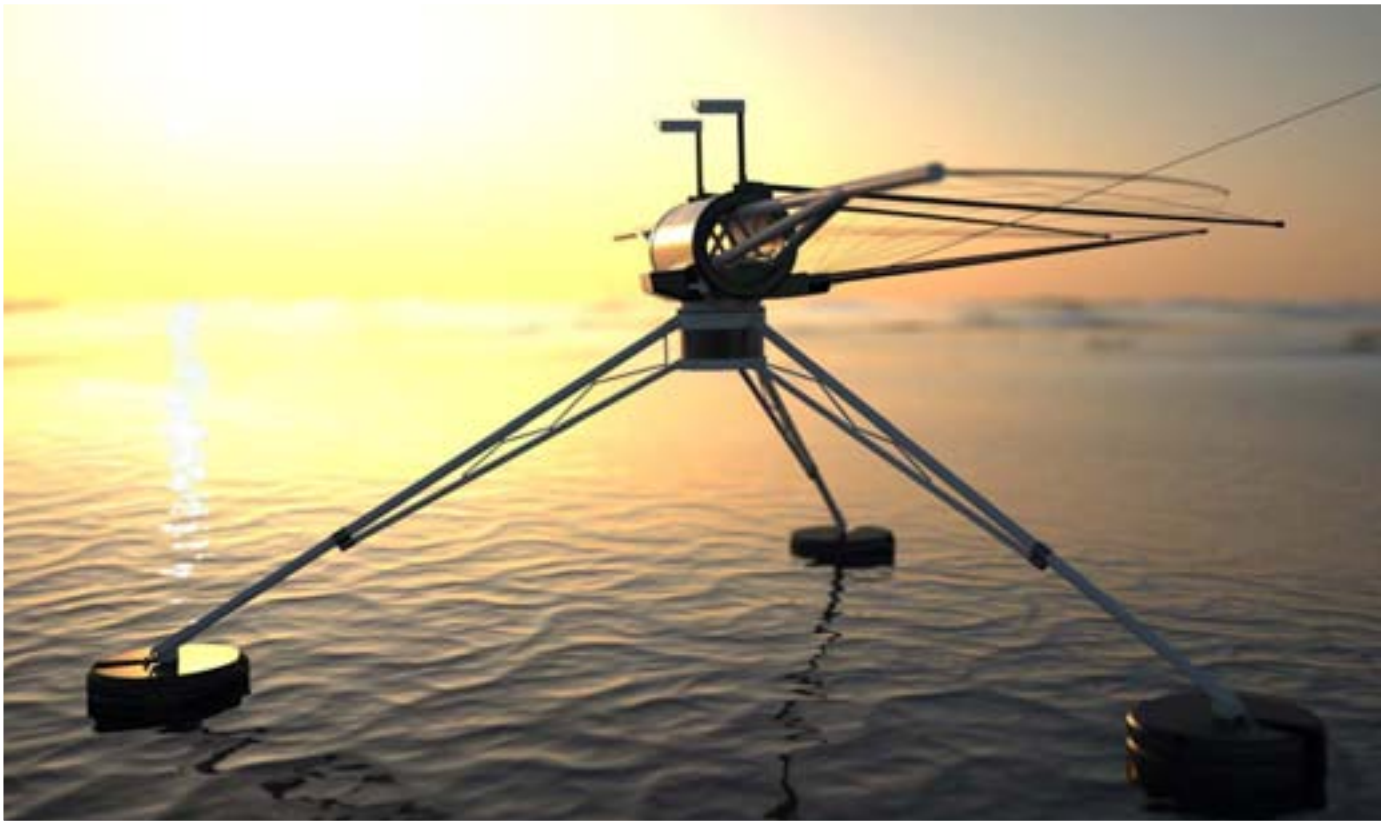


- \* CARBON FIBER SHELL
- \* STEERING MECHANISM
- \* DEPOWER MECHANISM
- \* RAM-AIR TURBINES
- \* COMPRESSOR
- \* COMPUTER
- \* BATTERY

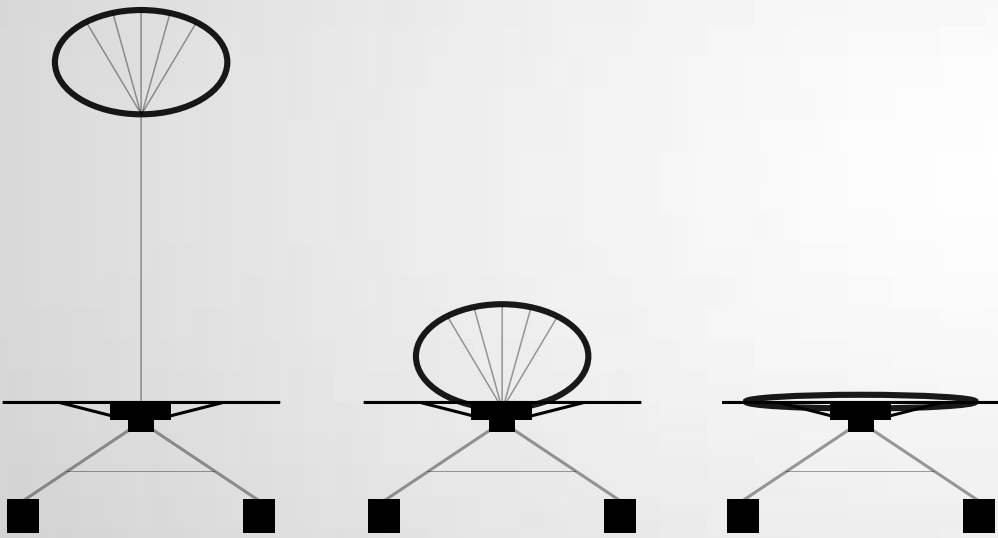


\*ground station

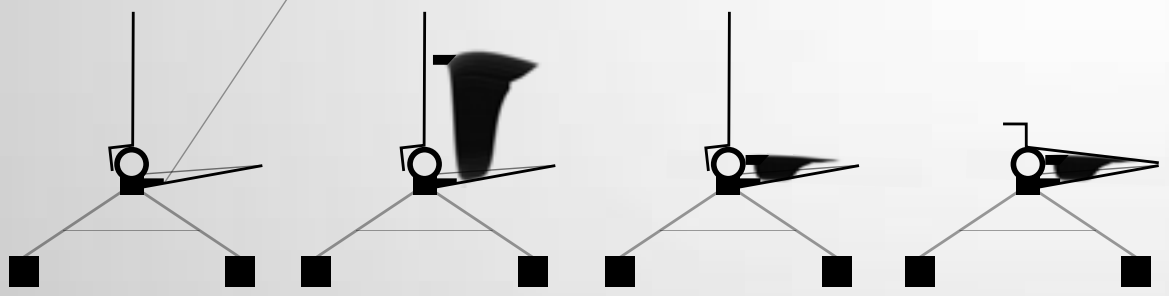
| \*PROVIDES LANDING AREA  
SUPPORTS GENERATOR



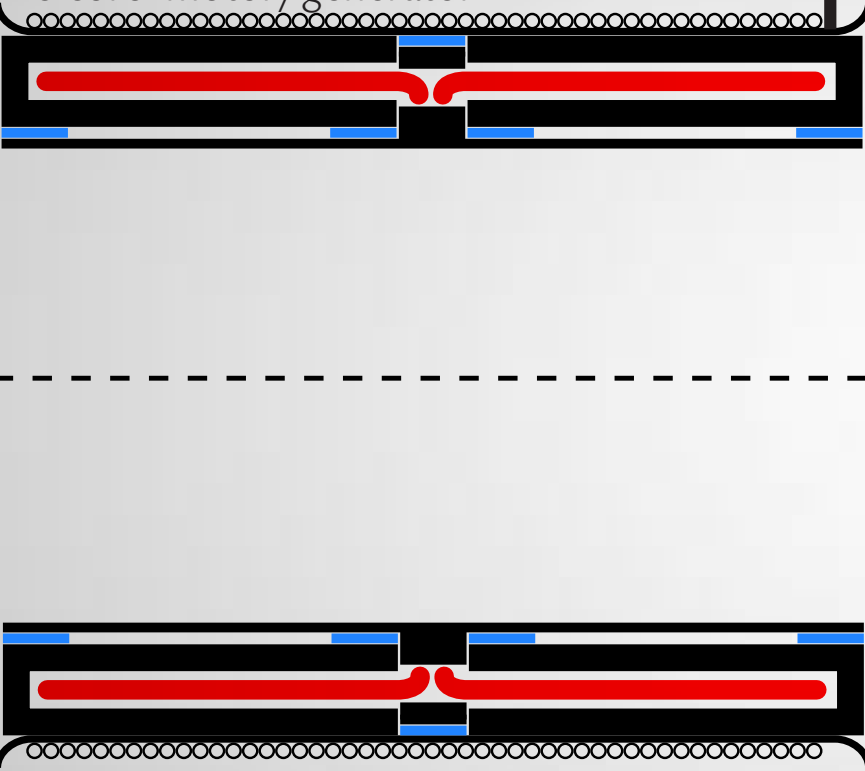
\*'static' landing



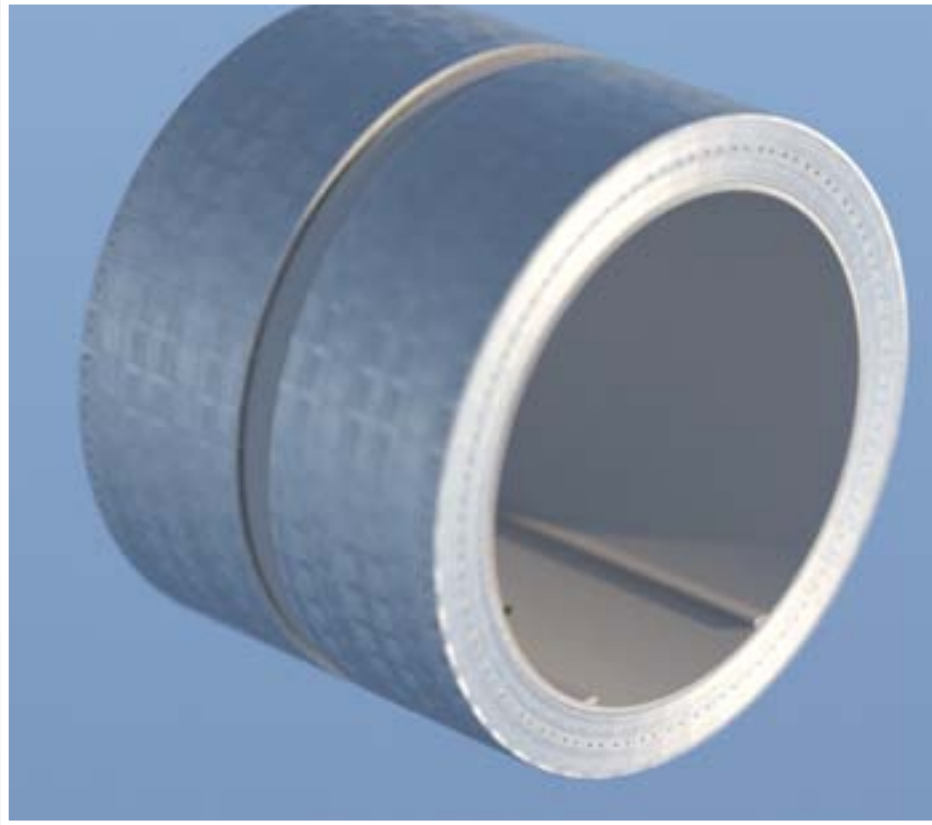
\*'static' landing



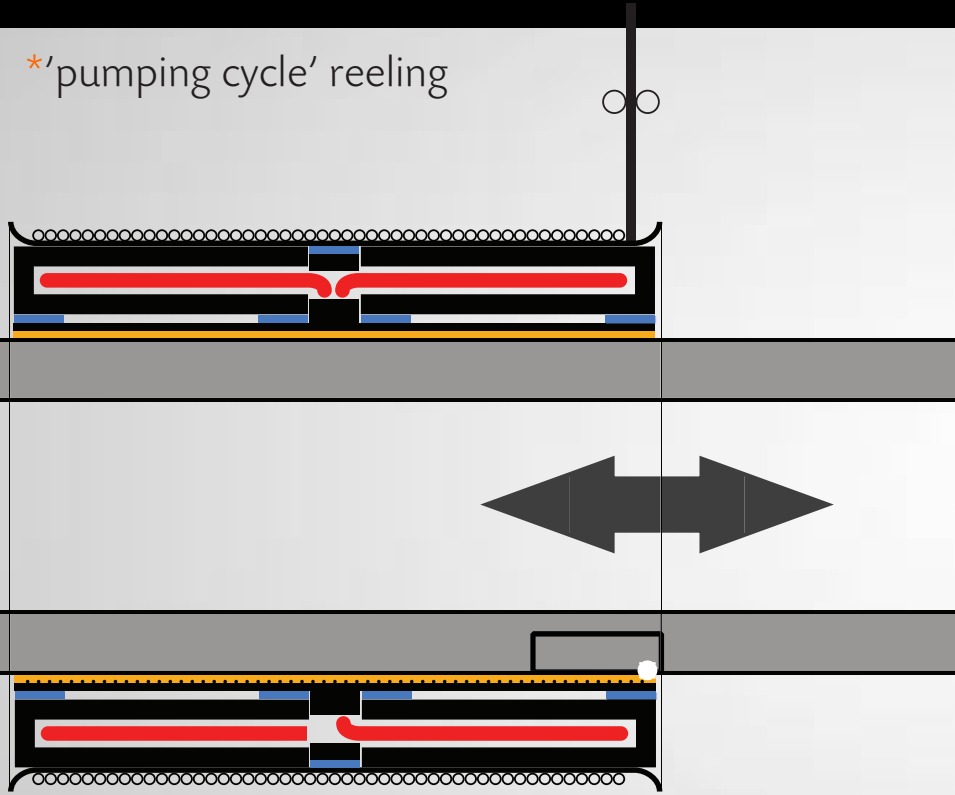
\*'c-core' motor/generator



— winding  
— bearing



\*'pumping cycle' reeling



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*KULeuven*

Johan Neyrinck, Product Development  
*Artesis*



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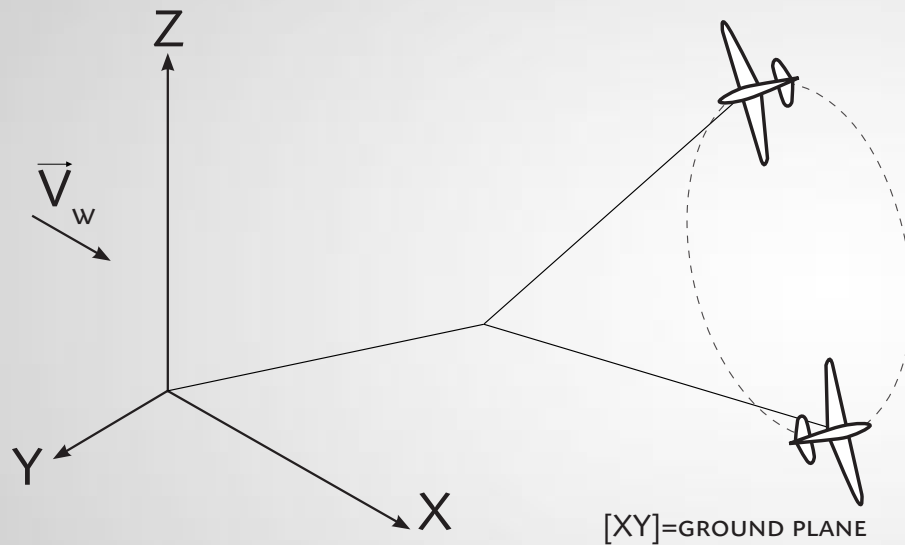
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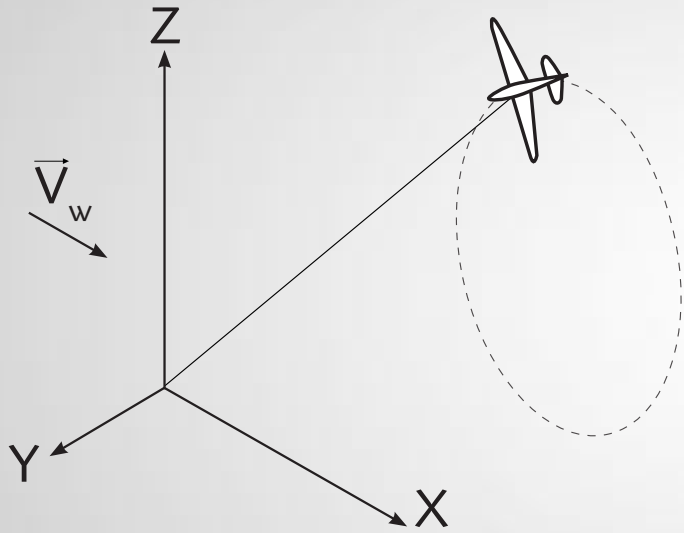
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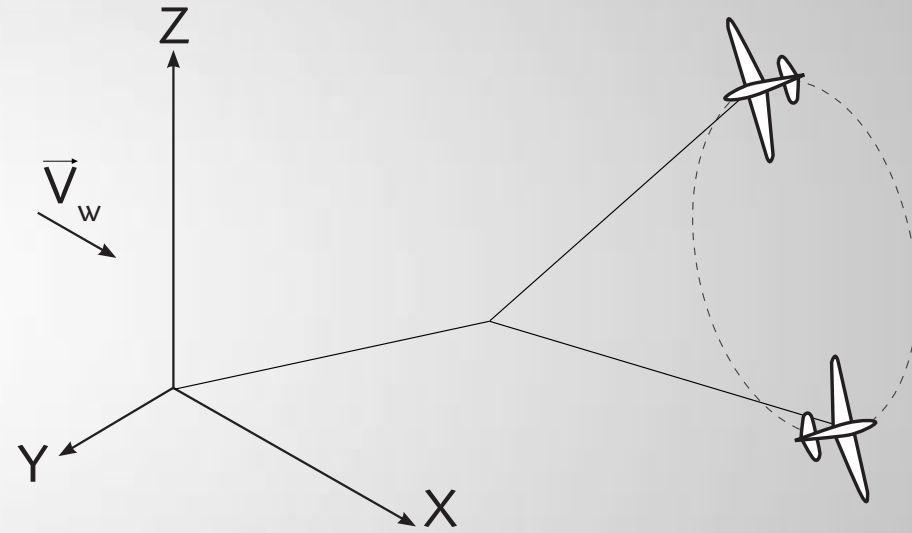
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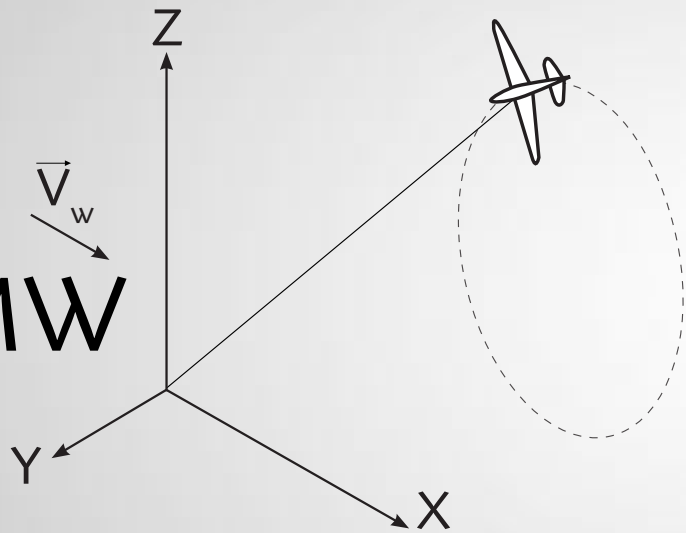
2X



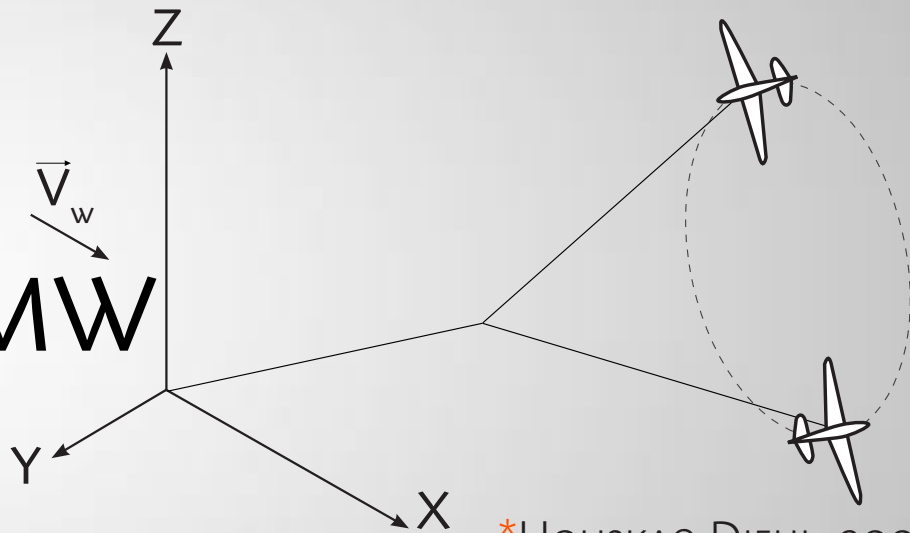
$\neq$



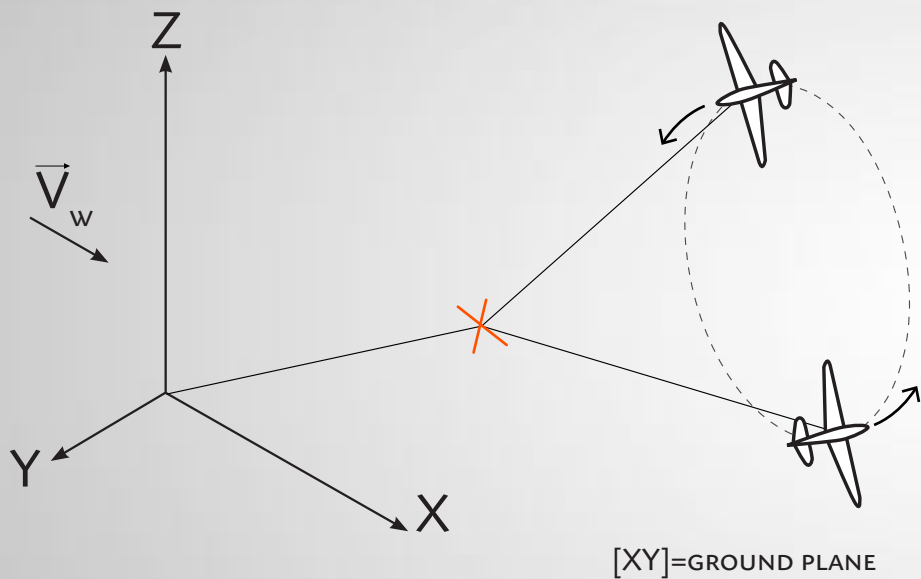
2X 5MW



14.8MW

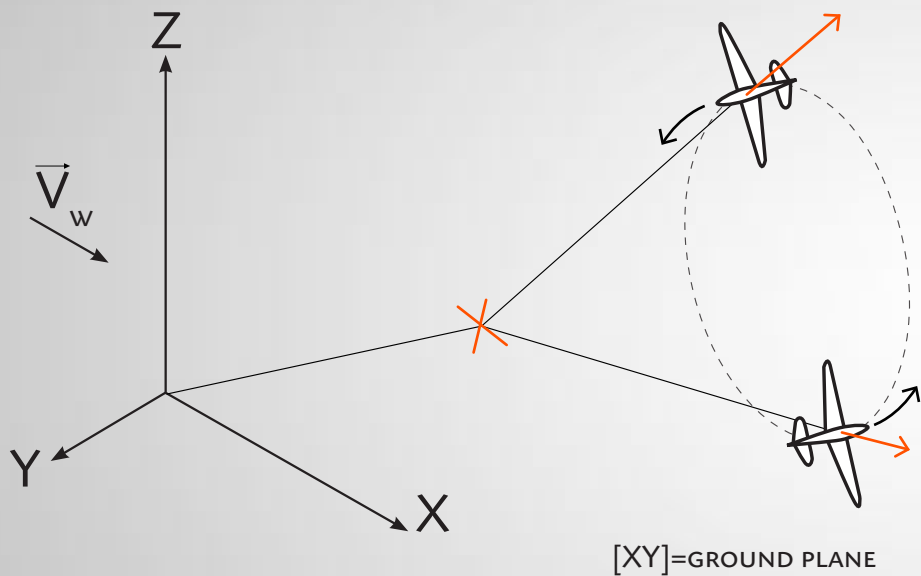


\*HOUSKA&DIEHL, 2007

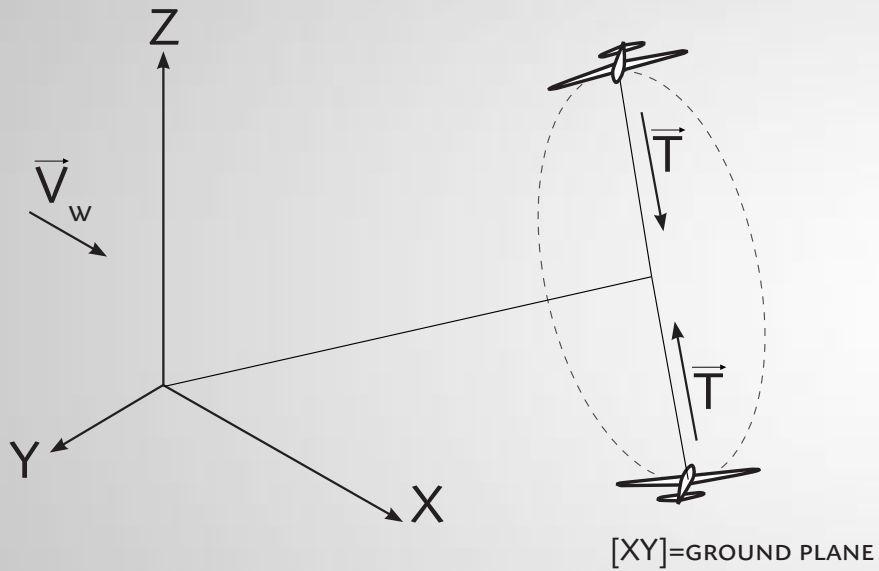


\*'Balanced Kites': advantages

1. less cable drag

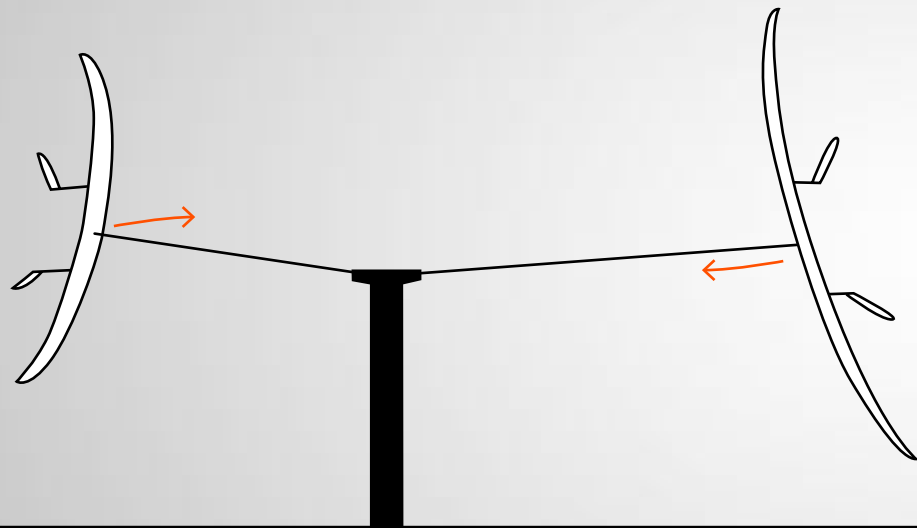


- \*'Balanced Kites': advantages
- 2. centripetal force balance



\*'Balanced Kites': advantages

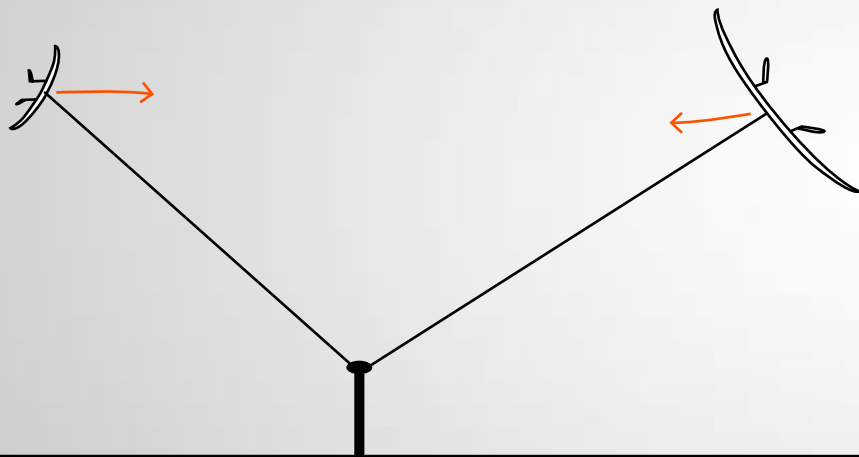
3. recuperation



\*'Balanced Kites': difficulties

launching & landing

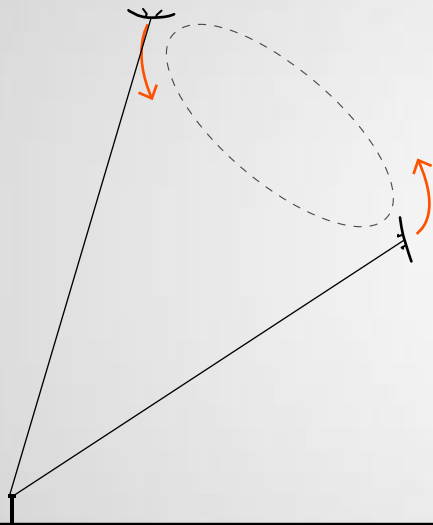
> rotation



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launching & landing

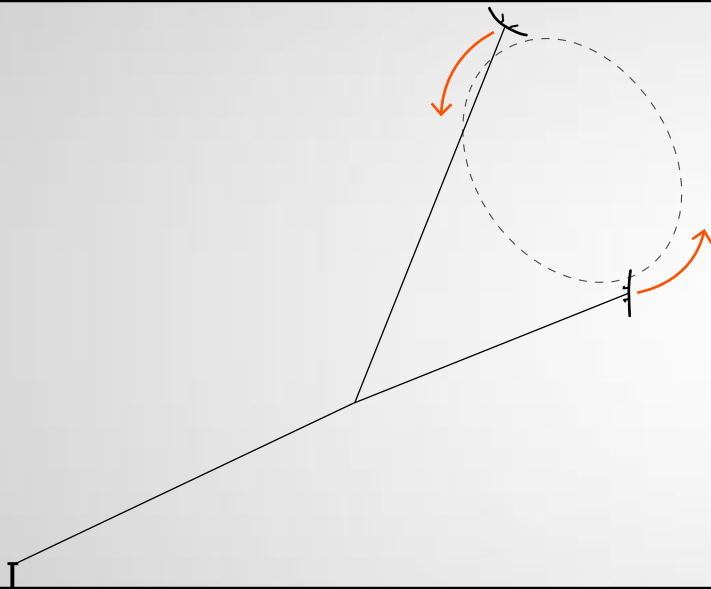
> rotation



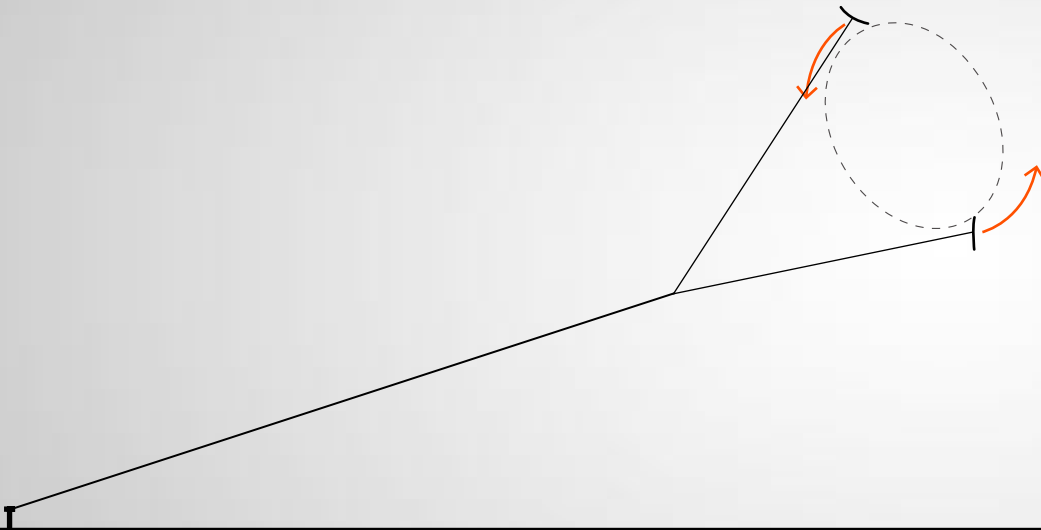
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launching & landing

> rotation



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launching & landing  
> rotation



\*'Balanced Kites': difficulties  
launching & landing  
> rotation

## \*PhD Research includes:

- \* COST OPTIMIZATION STUDY : WING CONSTRUCTION / ATTACHMENT POINTS /...
- \* FEASIBILITY STUDY OF BALANCED KITES
- \* DEMONSTRATION OF THE DESIGNED SYSTEM ON SMALL SCALE







# KITEPOWER

\* a product developer's approach

Reinhart Paelinck

*Airborne Wind Energy Conference, September 29, 2010*