

# Understanding hauling

Grunde Løvoll<sup>1</sup>

<sup>1</sup>Department of Physics  
University of Oslo  
Norway

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# Art vs. Science

- Art/poetry
  - Science
  - Magic
- 
- The way of a physicist
    - Reductionism...

# The important equations

- 1 Good casters do understand physics!
- 2 The two most important equations in fly casting

$$\Sigma \vec{F} = m\vec{a} = \frac{d\vec{p}}{dt} \quad (1)$$

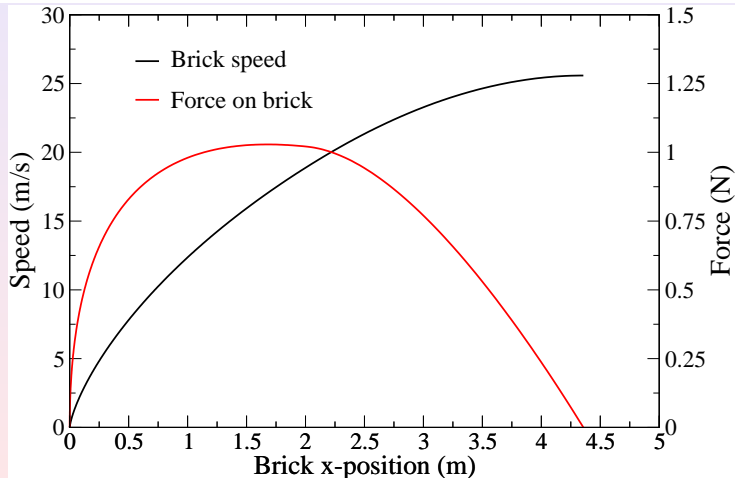
$$\Delta E_k = W = \int_S \vec{F} \cdot d\vec{s} \quad (2)$$

From these we get:

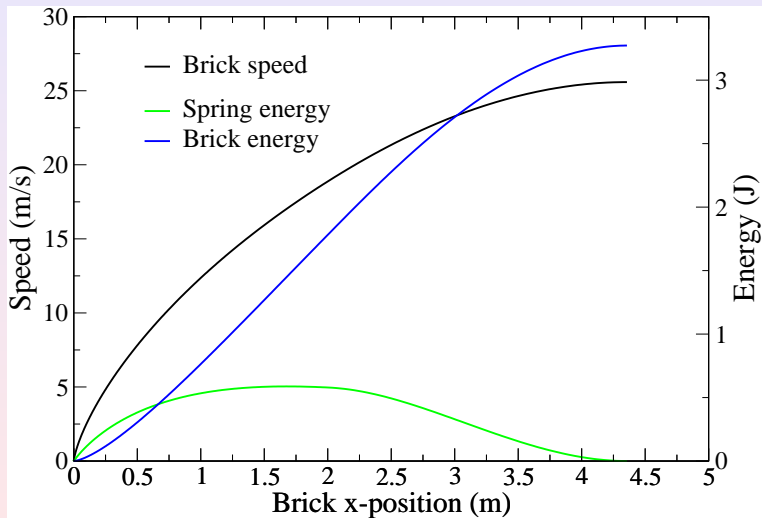
$$E_k = \frac{1}{2}mv^2 \quad (3)$$

$$P = \vec{F} \cdot \vec{v} \quad (4)$$

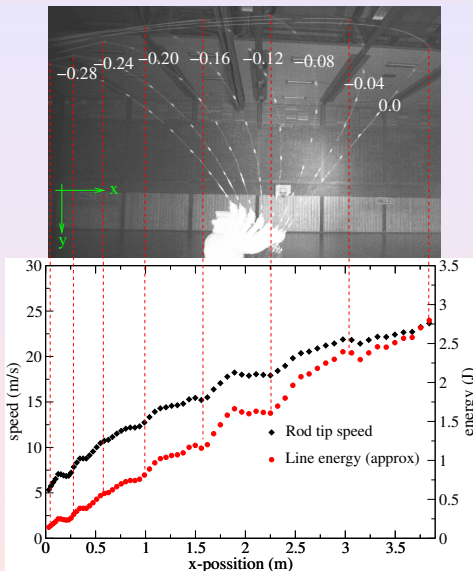
# Work–Energy and the brick spring problem

 $k = 0.9$ ,  $v_c(\text{max}) = 18 \text{ m/s}$ 
 $t = 0.000 \text{ s}$   
 $d = 0.000 \text{ m}$ 
 $x_c = 0.00 \text{ m}$   
 $x_b = 0.00 \text{ m}$ 
 $v_b = 0.0 \text{ m/s}$   
 $v_c = 0.0 \text{ m/s}$ 


# Work–Energy and the brick spring problem



# Work–Energy and a simple flycast



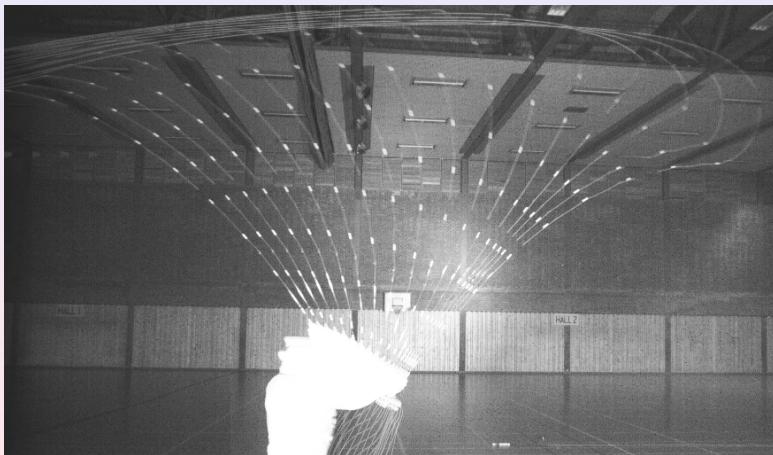
# Work–Energy comments

- Only two parameters we can vary:
  - 1 The force
  - 2 The length of the pathway
- Eq. (2) is the acid test of pet theories
  - 1 Whiplash
  - 2 50/50% speed from swing/spring
  - 3 ...



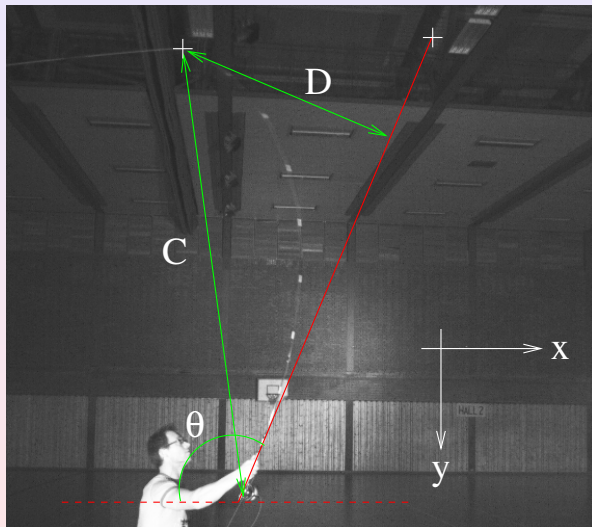
# Short cast

High speed video



# Short cast

Analyzing: Angular data



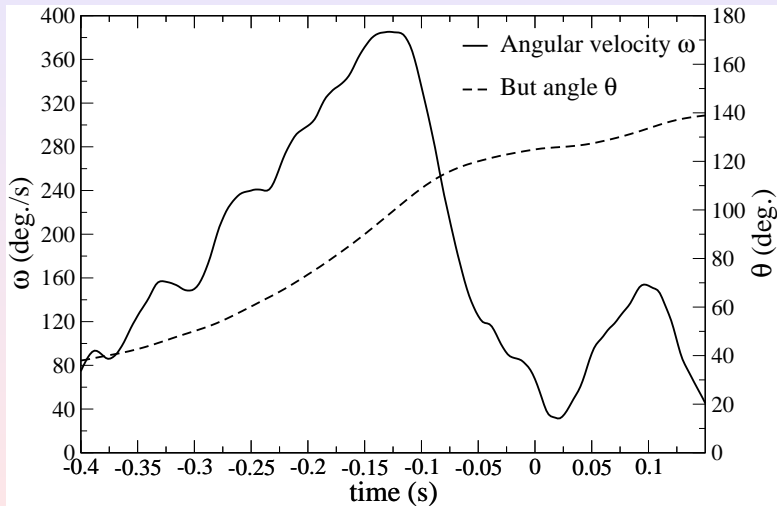
# Short cast

High speed video



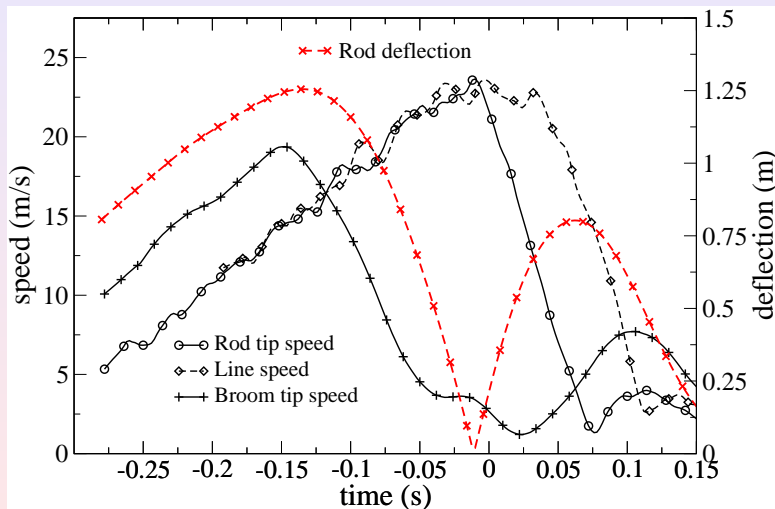
# Short cast

Analyzing: Angular data



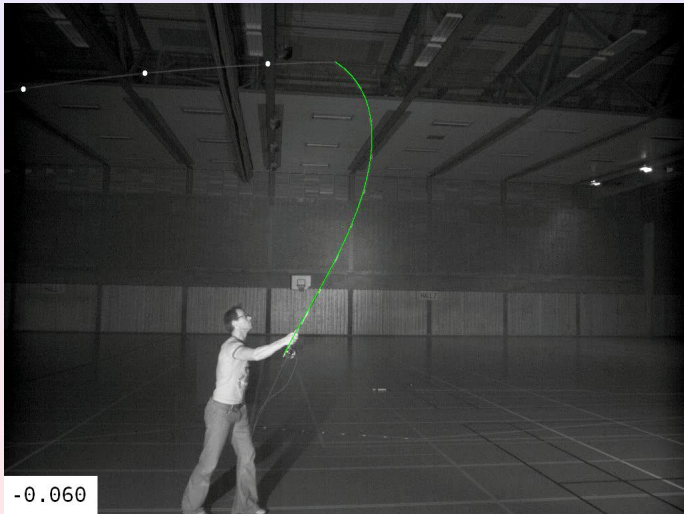
# Short cast

Analyzing: Speed and bend



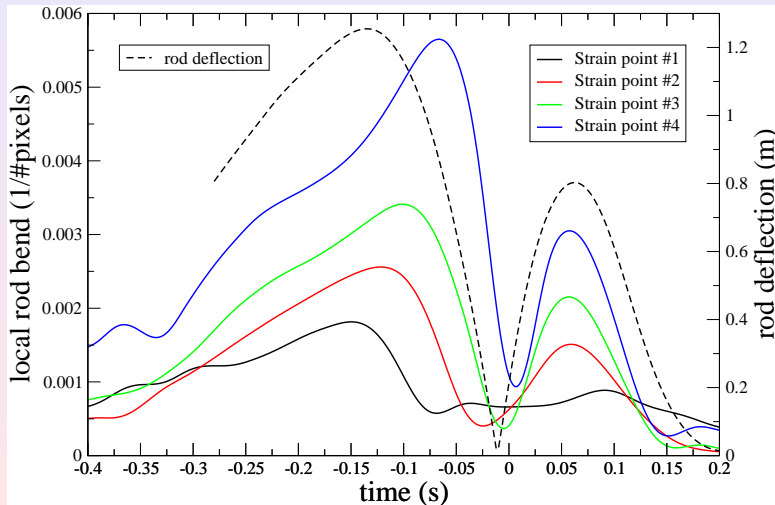
# Short cast

High speed video: The load shift



# Short cast

Analyzing: The load shift



# Short cast

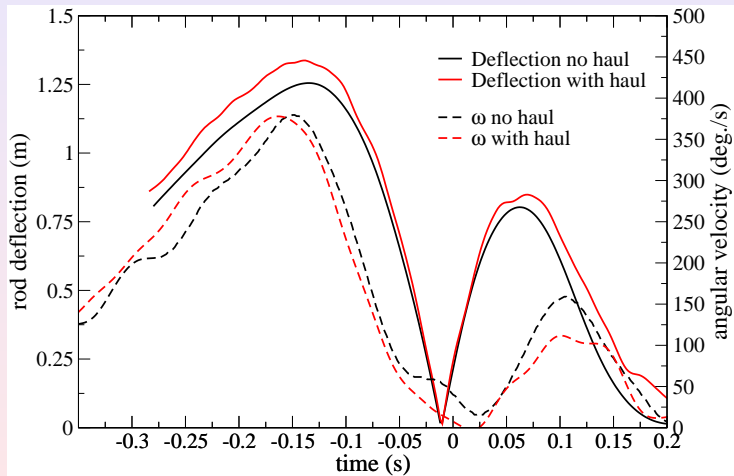
High speed video





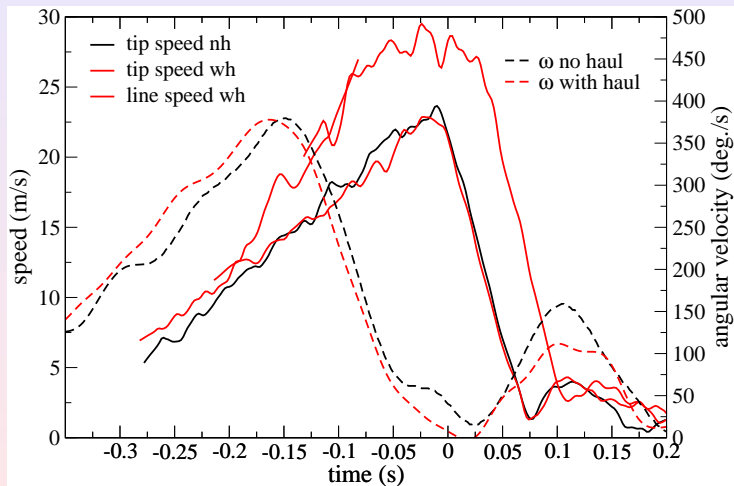
# Short cast

Compare with unhailed cast



# Short cast

Compare with unhailed cast



# Short cast

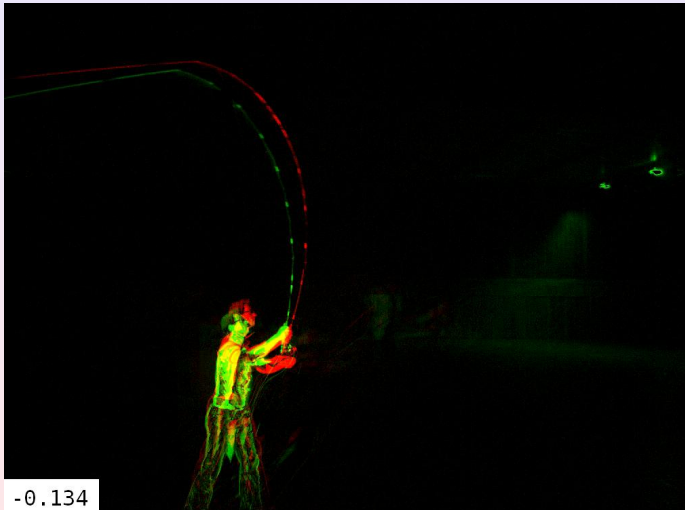
## Differences and Stroke adjustments

### Hauling make/give:

- Higher line speed.
  - For same peak angular velocity.
- Rotation “starts earlier”.
  - Makes timing easier.
- More rod-load.
  - Larger force on the line
- More load for a longer time and pathway.
  - Remember Eq. (2)?

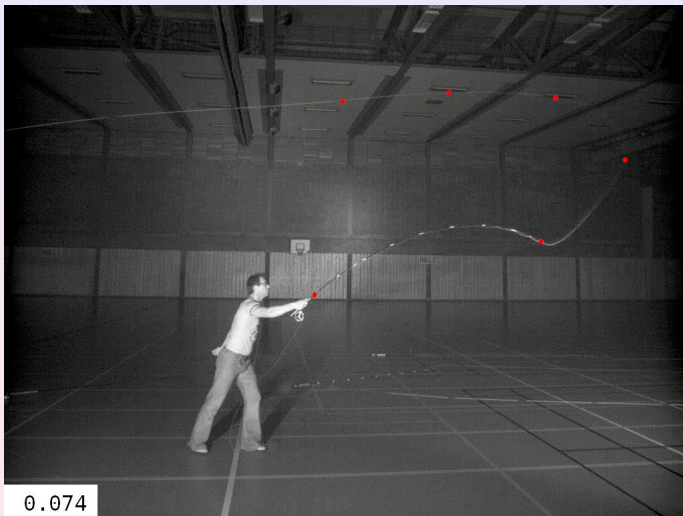
# Short cast

High speed video: Comparison with non-haul cast



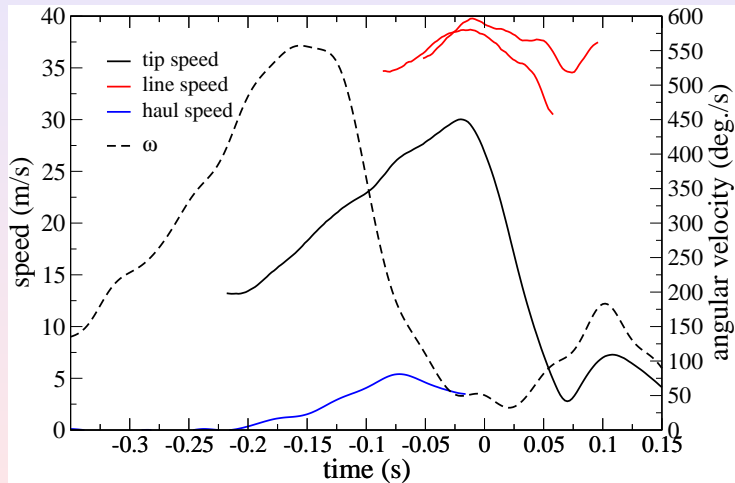
# Longer cast

High speed video



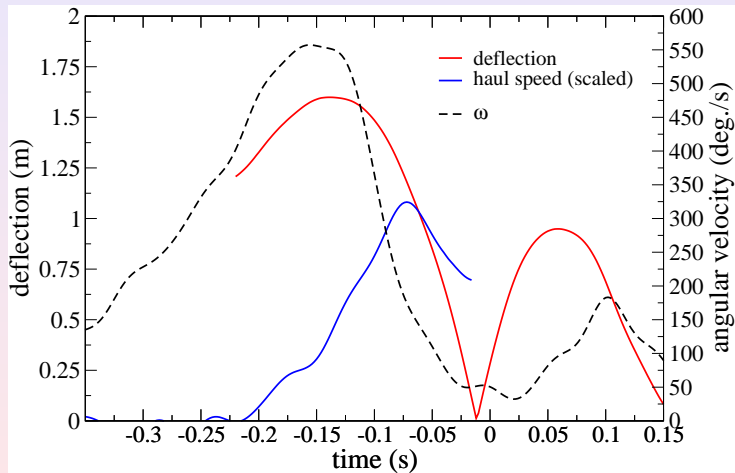
# Longer cast

Analyzing



# Longer cast

Analyzing



# Conclusion

- Adds energy to the system
  - Directly by/from the line hand
  - Indirectly by increasing and lengthening rod-load(-path)
- Physiological advantages.
  - Easier timing.
  - Distribute work and power between the hands, power and wrist strength are limiting factors.
- Most efficient when.
  - Rod load is high
  - Hauling length is long
  - Hauling “through the stop”



# Thanks to

- Knut Jørgen Måløy
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- Lee Cummings
- Torsten Hüter
- Gordon Judd
- Tom Larsen
- Marzio Giglio
- All the crazy loopers on *“The board”*

# Questions?