SMART PULLEY
(PHOTOGATE + SMART PULLEY ATTACHMENT)
DESCRIPTION D0386

Figure 1. The Smart Pulley

Short Description

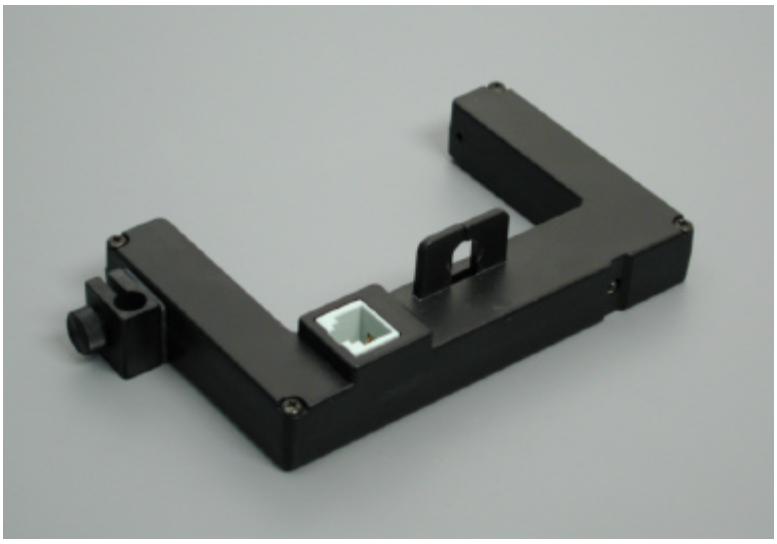

Figure 2. The photogate

The Smart Pulley consists of a photogate and smart pulley attachment.
The photogate has a narrow, infrared beam and fast response time, which provide very accurate signals for timing. When the infrared beam between the source and detector is blocked, the output of the photogate is low, and the light-emitting diode (LED) on the photogate goes ON. When the beam is not blocked, the output is high and the LED is OFF. The use of infrared makes the sensor relatively insensitive to room lighting.

The smart pulley attachment connects to the photogate by using the metal rod. Place the rod though the hole in the photogate and move the pulley into position so that the rod can be threaded into it. Tighten up the rod so that the pulley is held firmly against the photogate. When properly positioned, the spokes of the pulley will block the infrared beam of the photogate each time the spokes pass by.

The Smart Pulley is delivered with a BT plug and can be connected to the following interfaces:

- CMA ULab, CoachLab, CoachLab II, UIA/UIB boards through the Measuring Console (via 0520 adapter) and SMI (via 0520 adapter);
- Texas Instruments CBL™ and CBL2™ dataloggers;
- Vernier LabPro datalogger.

There is an adapter (art. 0520) to connect sensors with BT-plugs to 4-mm inputs.

The name of the Smart Pulley in the sensor library of Coach 5 program is
Smart Pulley (0386) (CMA)(0..2000).
Attention: Do **not** use the sensor **Smart Pulley (4mm) (CMA)(0..1000)**

Suggestion for experiments

Use of the photogate independently

This general-purpose photogate can be used for a wide variety of experiments:

- measuring the acceleration due to gravity (use a transparent piece of plastic with stripes at regular intervals, which can be allowed to fall through the photogate);

- studying the swing of a pendulum;
- measuring the speed of a rolling object;
- timing the period of a rotating object

Owing to the use of infrared light, the light gate is not suitable for counting drops.

Use of the smart pulley

The pulley can not determine the direction or change in direction. The pulley is therefore only useful where the movement is in one direction, as in:

- Atwood's experiment,
- a model boat being pulled along in water,
- a vehicle on an air track.

By connecting a belt between the pulley and a rotating object, rotations can also be investigated.
When the pulley is used in Event-based measurement activity, the pulley must be connected to the counter input and the negative going flanks (i.e. when the sensor moves from light to dark) are counted.

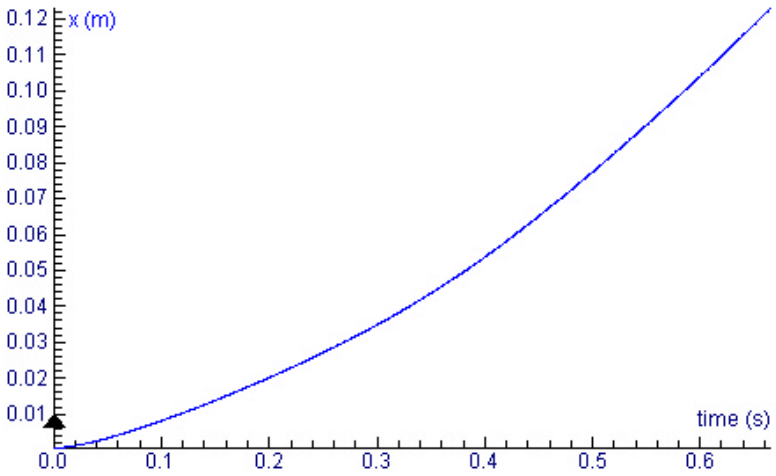

Figure 3. Result of Atwood's experiment.

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The pulley settings

The pulley has a V groove. The circumference of the wheel measured in the V groove is 0.15 m. On the edge of the groove the circumference is 0.16 m.
The movement of a cord as the pulley revolves is then to some extent dependent upon the thickness of the cord.
Calibration can be done by measuring the circumference with the cord that is going to be used and dividing the total by ten (10 spokes). We term this value the step size. This means that each time that a new gap in the pulley is reached there has been movement of this distance since the start of the last gap.
In the same way, event-based measurement can be prepared to measure with other settings for example for angular movements. When angular measurements are made, the step size is 2*ð/10 radians (0.628 rad).
When the pulley is used for the measurement of rotation of objects, the step size of the original angle can be determined as follows:

$$\Theta = \frac{2p}{10} * \frac{R_{pulley}}{R_{object}}$$

Technical data

Output	Dark: 0.03V Light: 4.98V
Detector rise time	< 500 ns
Detector fall time	< 50 ns
Parallax error	For an object passing within 1 cm of the detector, with a velocity less than 10 m/s, the difference between true and effective length is less than 1 mm.
Power requirements	5 V DC at 45 mA
Infrared source	Peak at 880 nm
Diameter of Pulley Circumference of pulley	In groove = 0.02387 m On edge = 0.02546 m In groove = 0.15 m On edge =0.16 m
Step size	Angle = 0.6283 rad = 36◦ Distance = 0.015 m to 0.016 m, dependent upon the thread used. 10 pulses (steps) per revolution
Connection	 BT (British Telecom) plug

This product is to be used for educational purposes only. It is not appropriate for industrial, medical, research, or commercial applications.

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