



LP PHOT 02 PHOTOMETRIC PROBE
LP UVA 02 RADIOMETRIC PROBE FOR ENVIRONMENTAL USE

LP PHOT 02

LP PHOT 02 probe measures illuminance (lux), defined as the ratio between the luminous flux (lumen) passing through a surface and the surface area (m^2). The spectral response curve of a photometric probe is similar to the human eye curve, known as standard photopic curve $V(\lambda)$. The difference in spectral response between LP PHOT 01 and the standard photopic curve $V(\lambda)$ is calculated by means of the error f_1 . It has been designed for long-time outdoor installation. The photometric measurement probe designed for outdoor readings, is basically used for taking weather and climate measurements during daylight.

2 Working principle

LP PHOT 02 probe is based on a solid state sensor, whose spectral response has been corrected by means of filters to adapt it to the response of the human eye. The typical relative spectral response curve is shown in fig.1. LP PHOT 02 is provided with a 50 mm diameter transparent glass dome, in order to protect the sensor against atmospheric damage. The cosine corrected response has been obtained through both the PTFE diffuser and case particular shapes. Deviation between the theoretical response and the real one, is shown in fig.2. The LP PHOT 02 cosine response allows for use even when the sun elevation is low.

Installing and mounting the probe LP PHOT 02 for global radiation measurements:

Before installing the luxmeter, the silica-gel cartridge must be refilled. Silica-gel crystals absorb humidity in the dome chamber and in case of particular climatic conditions, prevent internal condensation forming on the dome inner wall, with a consequent alteration in measurements.

Do not wet or touch the instrument with your hands while refilling the silica-gel cartridge. Carry out the following instructions in a dry environment:

- 1 Loosen the three screws that fix the white shade disk
- 2 Unscrew the silica-gel cartridge using a coin
- 3 Remove the cartridge perforated cap

- 4 Open the silica-gel sachet (supplied with the probe)
- 5 Fill the cartridge with silica-gel crystals
- 6 Close the cartridge with its own cap, and check that the sealing O-Ring is in the right position.
- 7 Screw the cartridge to the probe using a coin
- 8 Make sure the cartridge is tightly screwed (otherwise silica-gel crystal will last for a shorter time)
- 9 Position the shade and tighten it with the screws
- 10 The photometric probe is ready for use

- Fig.3 shows the operations needed to refill the cartridge with silica-gel crystals
- To allow cleaning the outer dome regularly and carrying out the instrument maintenance, LP PHOT 02 should be mounted in easily reachable places. At the same time, you should check that no building, tree, or any other obstacle exceeds the horizontal plane where the probe is mounted. In case this is not possible, you should find a place where obstacles do not exceed 5 degrees elevation over the path followed by the sun from rising until sunset.
 - The probe should be located far from any obstacle which might reflect sunlight (or any shadow) onto the probe.
 - For a correct horizontal placing, LP PHOT 02 is provided with a bubble level; inclination adjustment of the luxmeter is made by means of two leveling screws. Use the two 6mm-diameter screw holes with an interaxial distance of 65 mm, to mount the instrument on a plane. To access the holes, remove the shade disk and reposition it after mounting (see fig. 4).
 - LP S1 mounting kit (fig. 5) is supplied upon demand as an accessory, and allows for an easy mounting of the probe on a mast. The mast maximum diameter shall not exceed 50 mm. The operator will check that the mast height does not exceed the probe plane, in order to avoid measurement errors due to any reflection or shadow of the mast itself. To fix the probe to the mounting bracket, remove the shade disk by loosening the three screws, then fix the probe to the bracket and mount the white shade disk again.
 - The probe should be thermally isolated from the mounting bracket, and the electrical contact with the ground must be properly made.

Electrical Connections and requirements for electronic readout devices

- LP PHOT 02 probe does not require any power supply.
- Two models of LP PHOT 02 are available:
 - with a 5 m output cable (LP PHOT 02-5)
 - with a 10 m output cable (LP PHOT 02-10).
- LP PHOT 02 is supplied with a PTFE, UV resistant, braided shield and 2 wire cable. The color code is as follows:
 - black → braided shield
 - red → (+) positive pole of the signal generated by the detector
 - blue → (-) negative pole of the signal generated by the detector (in contact with the housing)

Fig.6 shows the wiring diagram:

- LP PHOT 02 has to be connected to a millivoltmeter or to a data acquisition system with input impedance higher than 100kΩ.

Maintenance:

In order to grant the best precision and accuracy in measurements, the outer dome must be always kept clean; the cleaner you keep the dome, the higher the accuracy in measurements will be. Washing can be made with water and standard lens paper; in case this wouldn't work, use pure ETHIL alcohol. After using alcohol, the dome must be washed with water only. Sudden rise and fall in temperature throughout day and night, might cause condensation to appear on the luxmeter dome; in this case the performed reading is highly overestimated. To reduce condensation, the probe is provided with a cartridge containing desiccant material, such as Silica-gel. Silica-gel efficiency decreases in time while absorbing humidity. Active silica-gel crystals are **yellow colored**, while they turn into **blue** when they gradually loose power. To replace them, see instructions. Silica-gel generally lasts from 2 to 6 months, depending on which climatic conditions you have and where the probe works.

Calibration and measurements:

Photometric probe sensitivity, indicated as S (or calibration factor), allows determining illuminance by measuring a signal in Volts at the probe ends. **S factor is measured in V/klux.**

- Once the difference of potential (DDP) has been measured at sensor ends, E_e illuminance is obtained through the following formula:

$$E_e = \text{DDP}/S$$

where;

E_e : indicates Illuminance expressed in klux,

DDP: indicates the potential difference expressed in mV and measured by the voltmeter,

S: indicates the calibration factor expressed in mV/klux and shown on the probe label (calibration factor is also mentioned in the calibration report).

Each photometric probe is factory calibrated and has its own calibration factor. Calibration is carried out by using a standard **illuminant A**, as indicated in CIE publication N° 69 "Methods of characterizing illuminance meters and luminance meters: Performance, characteristics and specifications, 1987". Calibration is carried out by comparison with a reference luxmeter, assigned to Delta Ohm Metrological Laboratory.

To get the best performances from LP PHOT 02, we strongly recommend to check calibration annually.

Technical specifications:

Typical sensitivity:	0,5 ÷ 2,0 mV/klux
Response time:	<0.5 sec (95%)
Impedance:	0.5 ÷ 1 KΩ
Measuring range:	0-200 klux
Viewing angle:	2π sr
Spectral range:	Standard photopic curve

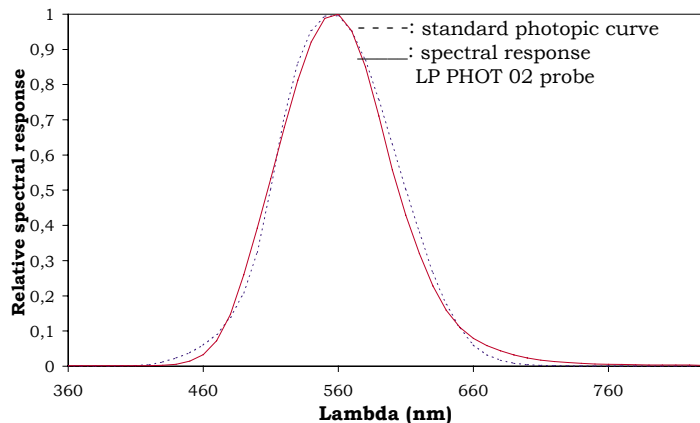


Fig. 1

Operating temperature:	-40 °C ÷ 80 °C
Error f ₁	<9 %
Cosine response/directional error:	< 8 % (between 0° and 80°)
Long term instability (1 year):	< ±3 %
Non-linearity:	<1 %
Temperature response:	< 0.1%/°C
Weight:	0.90 Kg
Dimensions:	fig. 4

ORDERING CODES

LP PHOT 02-5: Photometric probe complete with shade disk, desiccant sachet with silica-gel crystals, 2 silica-gel cartridges, bubble level.

Connecting cable: 5 m

LP PHOT 02-10: Photometric probe complete with: shade disk, desiccant sachet with silica-gel, 2 silica-gel cartridges, bubble level.

Connecting cable: 10 m

LP S1: Mounting kit: bracket for attaching LP PHOT 02 radiometer to a mast, including fasteners and levelling screws.

LP SP1: UV resistant plastic shade disk. BASF LURAN S777K.

LP SG: Desiccant sachet with silica-gel crystals, complete with inner O-ring and cap.

LP G: Pack of 5 cartridges of silica-gel crystals.

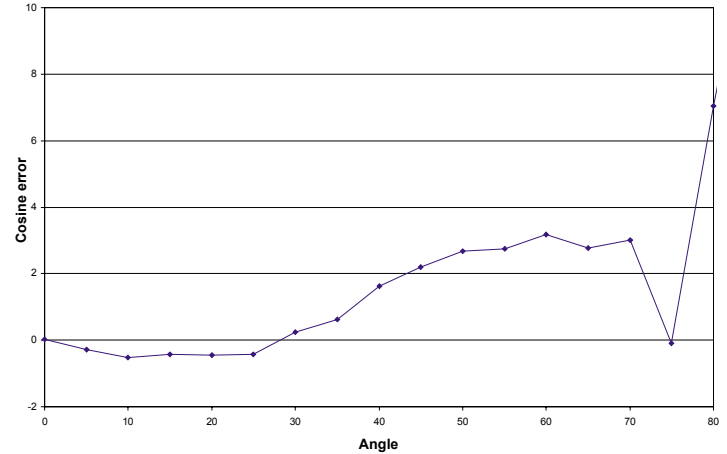


Fig. 2

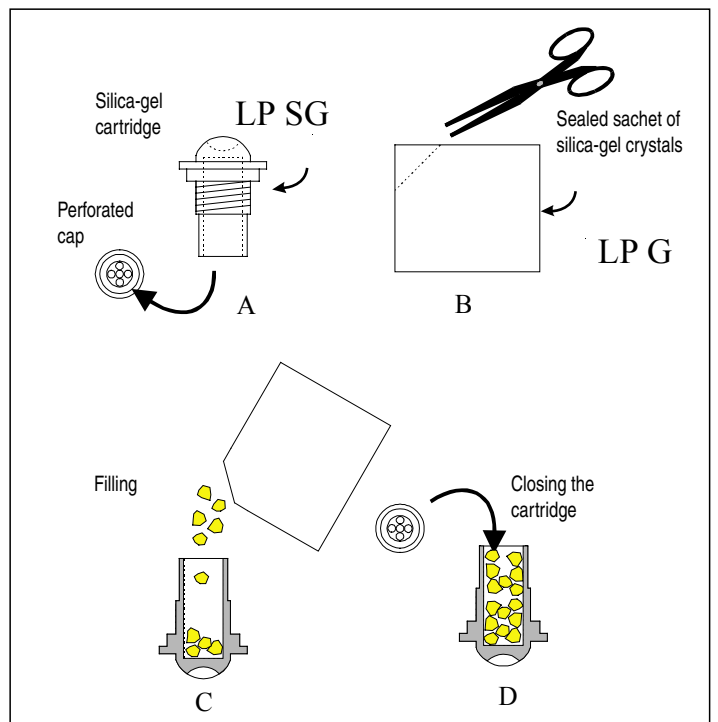


Fig. 3

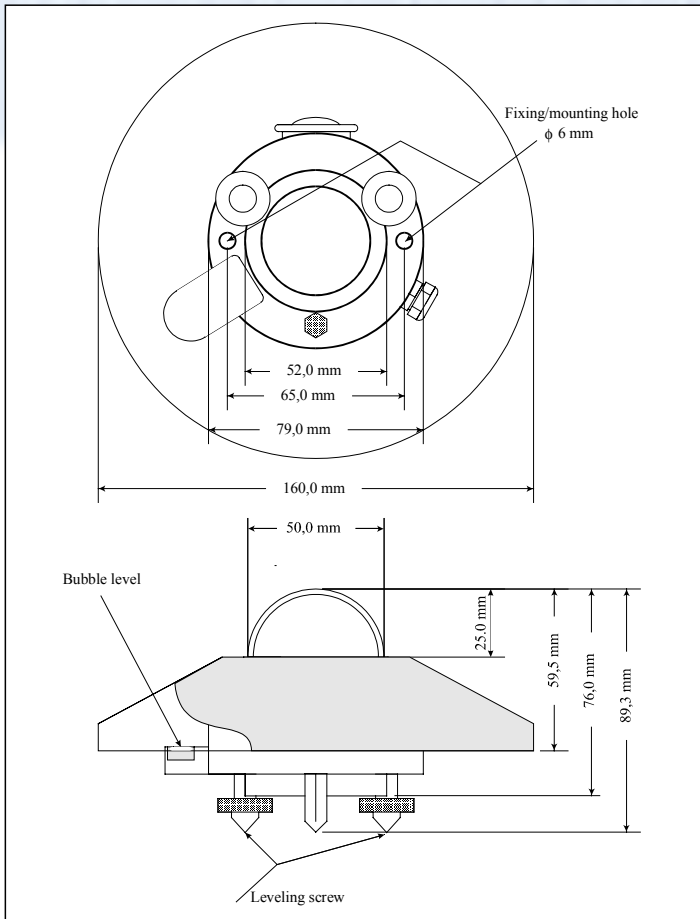


Fig. 4

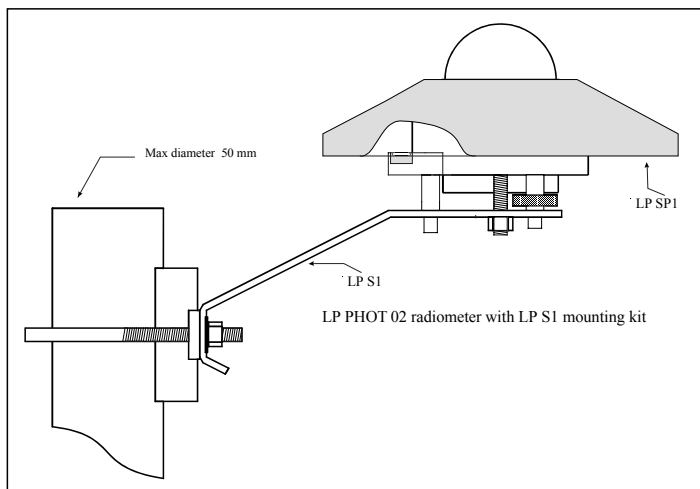


Fig. 5

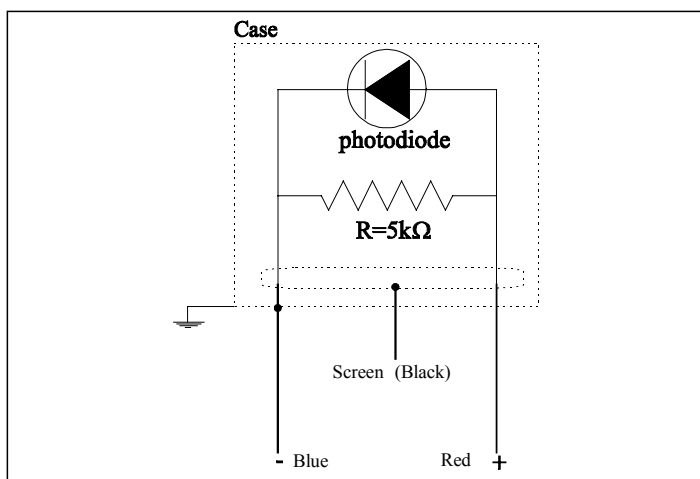


Fig. 6



LP UVA 02

The LP UVA 02 radiometer measures the broadband UVA irradiance on a plane surface (Watt/m^2). Measured irradiance is the result of the sum of direct solar irradiance and of diffuse irradiance.

The radiometer can measure the UVA irradiance in closed room too.

Working Principle

The LP UVA 02 radiometer is based on a solid state sensor, the spectral match with the desired curve is obtained using special filter. The relative spectral response is reported on figure 1.

In order to protect the diffuser from the dust, the LP UVA 02 radiometer is equipped with a 50mm glass dome.

The cosine low response is obtained with a particular shaped PTFE diffuser in figure 2 the cosine error versus angle of incident is reported

The good cosine low response of LP UVA 02 allow us the radiometer at any sun's zenith angle.

Installation and Mounting of the Radiometer for the Measurement of Global Radiation:

Before installing the radiometer, refill the cartridge containing silica-gel crystals. Silica gel absorbs humidity in the dome chamber and prevents (in particular climatic conditions) internal condensation forming on the internal walls of the domes and measurement alteration.

Do not touch the silica gel crystals with your hands while refilling the cartridge. Carry out the following instructions in an environment as drier as possible:

- 1- Loosen the three screws that fix the white shade disk
- 2- Unscrew the silica gel cartridge using a coin
- 3- Remove the cartridge perforated cap
- 4- Open the sachet containing silica gel (supplied with the radiometer)
- 5- Replace the silica gel crystals
- 6- Close the cartridge with its own cap, paying attention that the sealing O-ring be properly positioned.
- 7- Screw the cartridge to the radiometer body using a coin
- 8- Check that the cartridge is screwed tightly (if not, silica gel life will be reduced)
- 9- Position the shade disk and screw it with the screws
- 10- The radiometer is ready for use

Figure N.3 shows the operations necessary to fill the cartridge with the silica gel crystals.

- The LP UVA 02 radiometer has to be mounted in a readily accessible location to clean the dome regularly and to carry out maintenance. At the same time, check that no building, construction, tree or obstruction exceeds the horizontal plane where the radiometer lays. If this is not possible, select a site where obstructions do not exceed 5 degrees of elevation, in the path followed by the sun, between earliest sunrise and latest sunset. N.B The presence of obstructions on the horizon line significantly affects the measurement of direct irradiance.
- The radiometer has to be located far from any kind of obstruction, which might reflect sunlight (or sun shadow) onto the radiometer itself.
- The LP UVA 02 radiometer is provided with a spirit level for carrying out an accurate horizontal leveling. The adjustment is made by means of two leveling screws that allow to adjust the radiometer inclination. Use the two 6mm-diameter holes and a 65mm interaxial distance to mount the instrument on a plane. Remove the shade disk to access the holes and reposition it after mounting (see fig. 4).
- The LP S1 mounting kit (figure 5), supplied on demand as an accessory, allows an easy mounting of the radiometer on a mast. The mast maximum diameter shall not exceed 50 mm. The operator shall take care that the mast height does

not exceed the radiometer plane to avoid measurement errors caused by any reflection or shadow of the mast itself. To fix the radiometer to the mounting bracket, remove the shade disk loosening the three screws, fix the radiometer, and mount the white shade disk again.

- It is suggested to thermally isolate the radiometer from its mounting brackets, and to check that the electrical contact with the ground be done properly

Electrical Connection and Requirements for Electronic Readout Devices:

- The LP UVA 02 radiometer does not require any power supply.
- Two LP UVA 02 models are available:
 - with a 5 m output cable (LP UVA 02-5)
 - with a 10m output cable (LP UVA 02-10).
- The LP UVA 02 is supplied with a PTFE, UV resistant, screened (braid) and 2-wire cable. The colour code is:
 - Black → connected to the housing (screen)
 - Red → (+) positive pole of the signal generated by the detector
 - Blue → (-) negative pole of the signal generated by the detector
 The shield is connected to the housing. Connection diagram as per figure 6.
- The LP UVA 02 radiometer has to be connected either to a millivoltmeter or to a data acquisition system with input resistance > 5MΩ. Typically, the radiometer output signal does not exceed 20 mV. In order to better exploit the radiometer features, the readout instrument should have a 1μV resolution.

Maintenance:

It is important to keep the outer glass dome clean to grant measurement best accuracy. Consequently, the more the dome will be kept clean, the more measurements will be accurate. Washing can be made using water and standard papers for lens, or, in some cases, using pure ethyl alcohol. After using alcohol, clean again the dome with water only.

Because of the high rise/fall in temperature between day and night, some condensation might appear on the radiometer dome. To minimize the condensation growth, the radiometer is provided with a cartridge containing dessicant material: Silica gel. The efficiency of the Silica gel crystals decreases in the course of time while absorbing humidity. Silica gel crystals are active when their color is **yellow**, while they turn **blue** as soon as they loose their power. Read instructions about how to replace them. Silica gel typical lifetime goes from 2 to 6 months depending on the environment where the radiometer works.

Calibration and Measurements:

The radiometer **S** sensitivity (or calibration factor) allows to determine the irradiance by measuring a signal in Volts at the ends of the resistance which short-circuits the terminals of the photodiode ends. The **S** factor is measured in μV/(Wm⁻²).

- Once the difference of potential (DDP) has been measured at the ends of the sensor, the **E_e** irradiance is obtained applying the following formula:

$$E_e = \text{DDP}/S$$

Where:

E_e: is the Irradiance expressed in W/m²,

DDP: is the difference of potential expressed in μV and measured by the multimeter,

S: is the calibration factor in μV/(W/m²) shown on the radiometer label (and mentioned in the calibration report)

Pyranometers are factory calibrated one by one and they are marked by their own calibration factor.

The calibration is carried out following procedure N° DHLF-E-59. This procedure is used in the SIT calibration center N° 124 for the calibration of UVA radiometer. The calibration was performed by reference to Delta Ohm srl primary standard with monochromatic light at 365 nm obtained separating the emission line of a Xe-Hg lamp with an inferential filter. To get best performances from your LP UVA 02 it is strongly recommended that the calibration be checked annually.

At the moment no international agreement exist for the calibration of this kind of radiometer, so the calibration coefficient is dependent from the calibration procedure like reported in the following article:

“Source of Error in UV Radiation Measurements “, T. C. Larason, C. L. Cromer on “Journal of Reaserch of the National Institute of Standards and Technology” Vol. 106, Num. 4, 2001. (The article is free on the NIST’s WEB site at the following address : <http://www.nist.gov/jers>).

Technical Specifications:

Typical sensitivity:	150 ÷ 350 μV/(W/m ²)
Response time:	<0.5 sec (95%)
Impedance:	5 ÷ 7.5 KΩ
Measuring range:	0-1000 W/m ²

Viewing angle:	2π sr
Spectral range:	327 nm ÷ 384 nm (1/2) 312 nm ÷ 393 nm (1/10) 305 nm ÷ 400 nm (1/100)
Operating temperature:	-40 °C ÷ 80 °C
Cosine response:	< 8 % (tra 0° e 80°)
Long-term non-stability (1 year):	< ±3 %
Non-linearity:	<1 %
Temperature response:	< 0.1%/°C
Dimensions:	figura 4
Weight:	0.90 Kg

ORDERING CODES

LP UVA 02-5: Radiometer complete with shade disk, desiccant sachet with silica gel crystals, 2 silicagel cartridges, spirit level and Calibration Report. 5m-long output cable.

LP UVA 02-10: Radiometer complete with shade disk, desiccant sachet with silica gel crystals, 2 silicagel cartridges, bubble level and Calibration Report. 10m-long output cable.

LP S1: Mounting kit for LP UVA 02: bracket for attachment to a mast, including fasteners and leveling screws.

LP SP1: UV resistant plastic shade disk (BASF LURAN S777K)

LP SG: Desiccant sachet with silica gel crystals, complete with inner O-ring and cap.

LP G: Pack of 5 cartridges of silica gel crystals

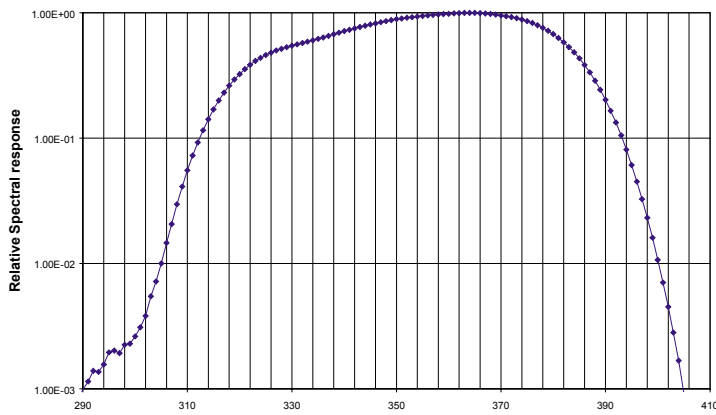


Fig. 7

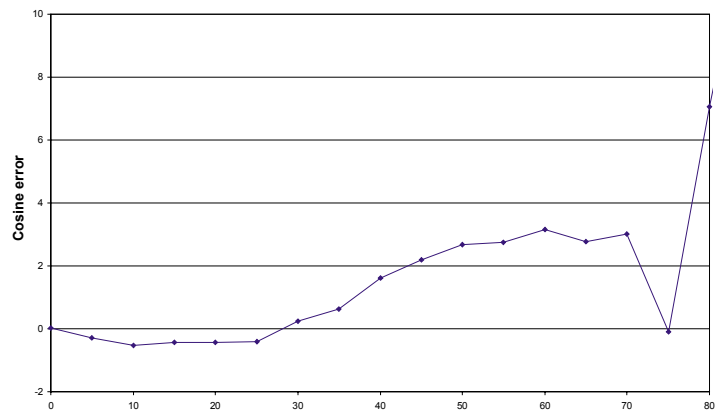


Fig. 8