Problem Set 11b – Complex Loops

Instructions

1. This problem set contains paired programming and individual programming problems. Each problem has a set of deliverables that needs to be submitted. You are responsible for following the appropriate guidelines and instructions below. Create appropriately-named files as instructed.

2. Save all files to your Purdue career account in a folder specific to PS11b.

3. Compress all deliverables into one zip file named **PS11b_yourlogin.zip**. Submit the zip file to the Blackboard drop box for PS11b before the due date.

Deliverables List

Item	Type	Deliverable
PS11b Answer Sheet	Individual	PS11b_Answer_Sheet_*yourlogin*.docx
Problem 1: Window Blinds Revisit	Individual	PS11b_blind_exec_revisit_*yourlogin*_report.pdf PS11b_blind_exec_revisit_*yourlogin*.m PS11b_all_fracs.p PS11b_full_illum.p PS11b_part_illum.p

Problem 1: Window Blind Loop – Revisit PS05

Individual Programming

Problem Setup

In PS05 Problem 2, you created a set of UDFs to calculate the transmission and absorption of solar energy through horizontal venetian blinds. You used equations that assume the full width of a blind slat is illuminated by sunlight. Reread the Problem Setup to remind yourself of the original problem, which will be helpful as you solve this problem.

A solar cell manufacturer has an idea to place solar cells on horizontal window blinds that can be used to charge small electronic devices. They are interested in the absorption characteristics of their prototype blind. Its parameters are shown in Table 1.

Table 1. Solar cell blind parameters

Parameter	Solar Cell Blind
Slat Spacing (S)	90 mm
Slat Width (W)	100 mm
Absorptivity Constant (α)	0.5

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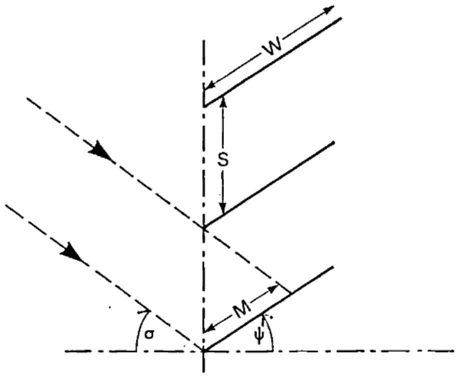
Recall the following definitions from PS05:



The geometric parameters of a blind are:

W = slat width (mm)

S = slat spacing (mm)

M = width of slat illuminated (mm)

σ = vertical shadow angle (given in deg)

ψ = slat angle (given in deg)

The blind surface material will have an absorptivity constant, α, that is a dimensionless value between 0-1.

Shadow angle represents the angle of the sun shining on the blinds. The slats can move through a range of angles as the blind opens and closes.

The value M is the width of a slat that is illuminated. It is calculated using the formula

$$M = \frac{S\cos\sigma}{\sin(\psi + \sigma)}$$

If M is greater than or equal to W, then each slat is fully illuminated as in PS05. When M is less than W, only part of each slat is illuminated. To account for both possibilities, you will need to calculate two new fractional values, F4 and F5, along with F1, F2, and F3 from PS05. The absorption calculation is different depending on whether the slats are fully illuminated (as in PS05) or partially illuminated.

The manufacturer has provided you with three p-code files that will calculate the fraction values and the absorption values for both fully and partially illuminated blinds. The functions are described below.

The function **PS11b_all_fracs.p** that calculates all five fraction values. The help lines for the p-code are as follows.

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% Program Description
%    Calculate fractional values used in absorption calculations for venetian blinds.
%
% Function Call
%    [F_vector] = PS11b_all_fracs(slat_data,M)
%
% Input Arguments
%  1. slat_data = 1x5 vector of [S,W,psi,sigma,alfa]
%        S: slat spacing (mm)
%        W: slat width (mm)
%        psi: slat angle (radians)
%        sigma: shadow angle (radians)
%        alfa: absorptivity constant (dimensionless)
```

```
%  2. M = width of illumination on slat (mm)
%
% Output Arguments
%  1. F_vector = a 1x5 vector that contains F1, F2, F3, F4, F5
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

To calculate the blind's absorption when the slats are fully illuminated (as in PS05), use the **PS11b_full_illum.p** function. This function works as described in the following help lines.

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% Program Description
%    Calculate fraction of incident radiation absorbed by a venetian blind when the
%    slats are fully illuminated.
%
% Function Call
%    [Absorption] = PS11b_full_illum(F_vec, slat_data)
%
% Input Arguments
%  1. F_vec = 1x5 vector of [F1 F2 F3 F4 F5]
%  2. slat_data = 1x5 vector of [S, W, psi, sigma, alfa]
%        Note: psi and sigma must be in radians
%
% Output Arguments
%  1. Absorption = absorption fraction (dimensionless)
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

To calculate the blind's absorption when the slats are partially illuminated, use the **PS11b_part_illum.p**. This function as described in the following help lines.

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% Program Description
%     Calculate fraction of incident radiation absorbed by a venetian blind when the
%     slats are partially illuminated.
%
% Function Call
%     [Absorption] = PS11b_part_illum(F_vec, alfa)
%
% Input Arguments
%  1. F_vec = 1x5 vector of [F1 F2 F3 F4 F5]
%  2. alfa = alpha, the absorptivity constant (dimensionless)
%
% Output Arguments
%  1. Absorption = absorption fraction (dimensionless)
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

The manufacturer wants you create an executive function that uses their p-codes to calculate the absorption fraction of the blind for a range of slat angles at given shadow angles. The executive function must meet the following criteria.

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- Calculate the absorption fraction for slat angles every 10 degrees from 10 to 170 when the shadow angle is 15, 30, or 45 degrees.
- Create a matrix of absorption values where each row corresponds to the shadow angle setting and each column corresponds to the slat angle setting.
    - Initialize the absorption matrix using zeros.
- Call the appropriate UDFs to calculate absorption values for each possible shadow angle and slat angle
- Plot, on a single figure window, the absorption vs slat angle for each shadow angle setting. Use lines instead of the data markers.

Problem Steps

1. **Before you start to code**: Create a flowchart to outline how information should move through the executive function code. Draw the flowchart using any means that result in a clear image for the answer sheet. Make sure your flowchart is legible!
2. In your Word answer sheet:
    a. Insert a clear image for each of your executive function flowchart.
3. Create a new copy of your blinds executive function from PS05 and name it **PS11b_blind_exec_revisit_*yourlogin*.m**. Adapt it to meet the requirements above.
4. Publish your executive function as a PDF named **PS11b_blind_exec_revisit_*yourlogin*_report.pdf**.

Reference: http://bse.sagepub.com/content/1/2/83.full.pdf