# CPSC 314
# Computer Graphics

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Lecture 16: Midterm Review

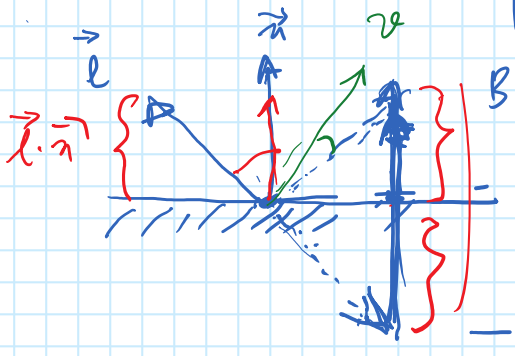


## Preliminaries

- Reminders and Announcements
  - Midterm on Friday Feb 18, **during class**, answer on Canvas using your laptop.
    - **The actual location will be ANGU 098 (please locate in advance!)**
- Today
  - Some remaining bits about basic Shading and Texture Mapping
  - Review of transformations about 'auxiliary frames' (Text 5.2.1, Lecture 10)
  - Review for Midterm
    - **This will primarily be a Q&A session.**

# § Specular part of Phong reflection model

## Bounce Vector Computation



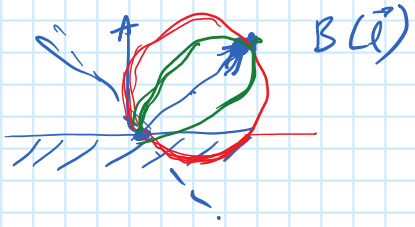

assume $\|\vec{l}\| = \|\vec{n}\| = \|\vec{v}\| = 1$

$$B(\vec{l}) = -\vec{l} + 2(\vec{l}\cdot\vec{n})\,\vec{n}$$

$$= 2\,\vec{l}\cdot\vec{n}\;\vec{n} - \vec{l}$$

First attempt:

$$\text{Intensity} = k_s \; B(\vec{l}) \cdot \vec{v}$$



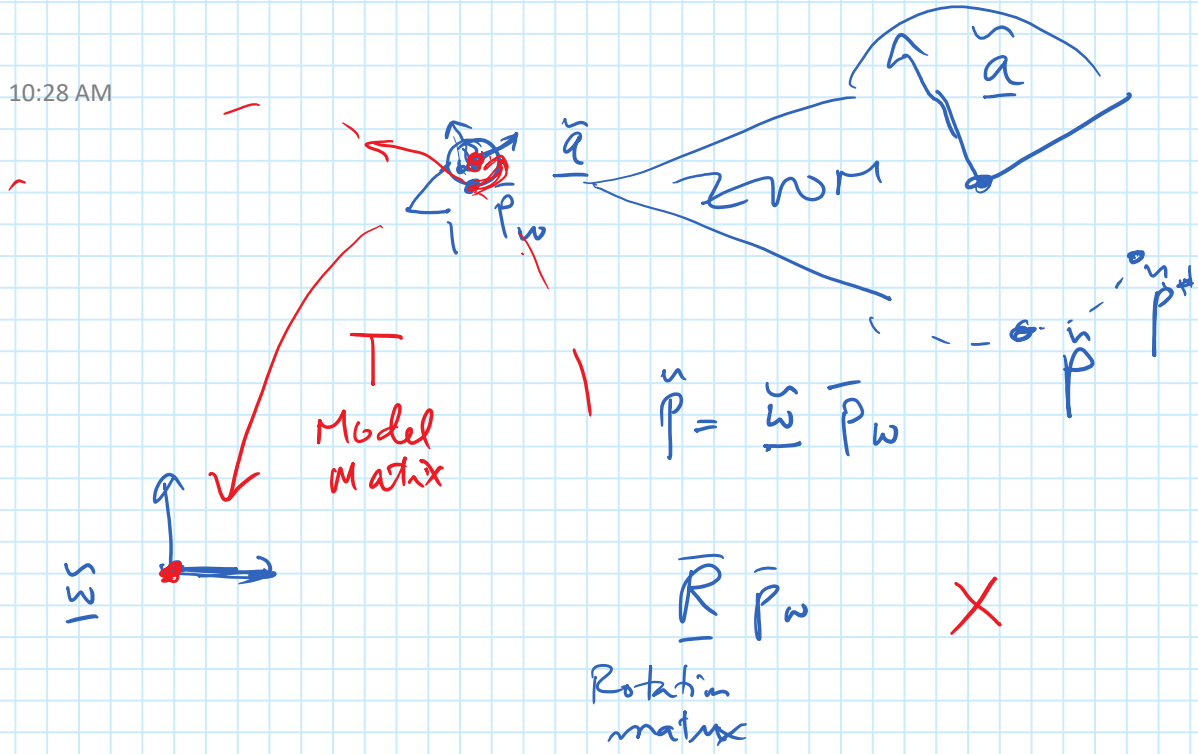

Problems: ① Can get -ve Intensity

② Too diffuse

Final:

$$I_s = k_s \max\left(0, (\vec{B}\cdot\vec{v})\right)^{\sigma}, \quad \sigma \geq 1$$

$\sigma$: Shininess exponent




$$\underline{p}_a = T^{-1}\ \underline{p}_w$$

After rotation in the $\underline{a}$ frame

$$\underline{p}_w^* = \boxed{T R T^{-1}}\ \underline{p}_w$$

"Similicity transform"

## About “in class” quizzes and midterm

Similar to Quiz 1, but in-person only

- Duration 50 minutes, closed book, closed Internet, no communication with any human about exam.
- During the class hour

## Midterm structure

- Exam is for 50 minutes, in class
- Budget 45 minutes for doing the quiz (One minute per mark)
- 4 Types of Question (Parts A,B,C,D)
  - Parts A-C: as in Quiz 1. 35 Marks
    - T/F questions. 1 mark each
    - “Recognition” Fill in the blanks (with multiple choice). 1 mark each (note: less than Quiz 1)
    - “Computing” Solve a small problem, and select the correct answer.
- Part D (10 marks). Solve a problem from a verbal description.
  - Either enter free-form answer or upload a file with answer for marking.

# Midterm Preparation

- CAREFULLY review ALL lectures before exam (including review lecture).
- Greater emphasis on topics covered after Quiz 1
  - Frames. Ch. 5.2, esp. 5.2.1 “transformation about an auxiliary frame”
  - Chains of transformations
  - Types of transformations (TRS). Ch 2.4,2.5,2.6, and 3.4
  - Scene Graphs and Hierarchies. Ch 5.4.
    - Mainly focus on lecture notes (Three.js version)
  - Projection. Ch 10. Mainly focus on lecture notes
  - Depth. Ch 11.2 and 11.3 only. Skip 11.2.1
  - Rendering 1 (Ch 14, skip 14.4)
  - Texturing 1 (Ch 15.1)

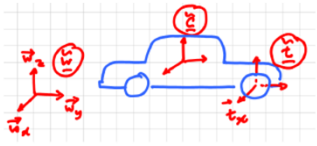
5

# Midterm Preparation

- Review material from Quiz 1 too!
- Review Assignments 1 and 2

6

# Example of Part D



You are given the task of animating a car driving on a road. The geometry of all the parts of the car, including the tires, is given in the "car frame," $\underline{\tilde{c}} = \underline{\tilde{w}}\ \underline{\tilde{C}}$. $\underline{\tilde{w}}$ is fixed to the world. Suppose $\tilde{p}$ is a point on the tire, with coordinates $\overline{p}_c$ in frame $\underline{\tilde{c}}$.

(a) The car is moving to the right (in the $\vec{w}_y$ direction) with speed $v$ m/s. What are the coordinates of $\tilde{p}$ in the world frame after $s$ seconds?

Answer: To move all points $p_c$ on the car to the right we pre-multiply by a translation matrix $M(s)$

$$p_w = M(s)\ C\ p_c$$

where

$$M(s) = \begin{pmatrix} 1 & . & . & . \\ . & 1 & . & vs \\ . & . & 1 & . \\ . & . & . & 1 \end{pmatrix}$$

(b) In addition to the above, your boss wants you to make the tires rotate at $r$ radians/s. Frame $\underline{\tilde{t}} = \underline{\tilde{c}}\ \underline{\tilde{T}}$ is located on the tire with its X-axis along the axis of rotation. Note that $\underline{\tilde{t}}$ is defined with respect to the car frame. What are the coordinates of $\tilde{p}$ in the world frame after $s$ seconds?

Answer: This is an example of "transforming about an auxiliary frame" that we looked at in Lecture ~~9~~. Now we need to rotate about the tire's x axis (in addition t the rightward motion).

Actually, this lecture
Text ch. 5.2.1

$$p_w = M(s)\ C\ T\ R(\theta)\ T^{-1}\ p_c$$

where the angle of rotation is $\theta = rs$ and

$$R(\theta) = \begin{pmatrix} 1 & . & . & . \\ . & \cos\theta & -\sin\theta & . \\ . & \sin\theta & \cos\theta & . \\ . & . & . & 1 \end{pmatrix}$$

# Uploading answers to Part D

- Answer the questions by entering the answers (including math) in the text box
  - Matrices should be formatted, with LaTeX

## Entering math in Canvas text boxes

Choose Math > Switch to Advanced

- 4X4 matrix template

```
\begin{pmatrix}
. & . & . & . \\
. & . & . & . \\
. & . & . & . \\
. & . & . & 1
\end{pmatrix}
```

- 3X3 matrix template

```
\begin{pmatrix}
. & . & . \\
. & . & . \\
. & . & 1
\end{pmatrix}
```

## Exam invigilation

- ANGU 098 has enough room for social distancing. Leave one space between each person. Some rows will be marked as “Do not use” to give TAs room to invigilate
- Place your UBC ID face up next to you to present to an invigilator
- During the exam you must not communicate with anyone. Doing so is a serious academic offence. More details posted on Piazza.

## Questions

**All the best for the mid-term exam!**