MSCS Mess

Department of Mathematics, Statistics and Computer Science December 6, 2004
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This Week's Colloquium

Title: Visual and Auditory Spatial Sensing
Speaker: Stan Birchfield,
Dept. of Electrical and Computer Engineering
Clemson University
Time: *Thursday*, December 8, 2:30 pm
(treats at 2:15)
Place: SC 182

We humans rely predominantly upon our eyes and ears to gather information about the three-dimensional world, such as the shapes and locations of objects. Similarly, video and audio are the two primary types of data used by computers for automatic sensing in 3D. In this talk I will discuss the two classic problems of stereo vision and acoustic localization. We will see that both problems share much in common, although they differ in many ways as well.

For both problems, I will describe some of the challenges involved, as well as the latest research trends. Stereo vision experienced a significant breakthrough a few years ago when algorithms based on graph cuts were shown to be able to minimize functionals over the entire image. I will describe these techniques and some extensions that have been added by myself and others, as well as point out situations in which the graph-cut algorithms fail. A similar breakthrough has occurred in acoustic localization, where researchers have recently discovered that all the signals can be taken into account in an efficient manner, thus replacing the previous sub optimal and time-consuming methods. I will describe our latest work on this problem, including a unifying framework that encompasses the recently discovered efficient method along with the Bayesian formulation and the traditional beamforming and time-delay-estimation methods. Together, this work on stereo vision and acoustic localization brings us a little closer toward achieving the goal of robust spatial sensing.

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Are you a first year student, interested in mathematics, not computer phobic and would like a solid good paying job for your next three years at St. Olaf? Then does Humke have the deal for you!!!

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Last Week's Problem

A soccer ball is made from pieces of black and yellow leather. The black pieces are regular pentagons and the yellow ones are regular hexagons. Each pentagon is adjacent to five hexagons and each hexagon is adjacent to three pentagons and three hexagons. The ball has 20 yellow hexagons. Does the ball have more than 10 black hexagons?

The only solution was submitted by **Adam Mcdougall '05**. This week I include two solutions. The first for its simplicity, but it requires knowing there are 20 hexagons. The second one does not require knowing there are 20 hexagons, makes nice use of Euler's formula and is largely due to Adam.

Solution 1: Since each yellow hexagon is adjacent to three black pentagons, if we go around each hexagon and count pentagons we get 20x3 = 60 pentagons. Since each pentagon is adjacent to 5 hexagons we have counted each pentagon 5 times giving 60/5 = 12 pentagons.

Solution 2: Euler's formula states that, for a planar graph, the number of vertices (V) minus the number of edges (E) plus the number of faces (F) is 2. At each vertex there are two hexagons and one pentagon, so each vertex on a hexagon contributes 1/3 of a vertex toward the total number of vertices counted for Euler's formula. Thus there are 6/3 = 2 vertices contributed by a hexagon. Similarly, there are 5/3 vertices contributed by a pentagon. Each edge of a hexagon is shared by one pentagon or one other hexagon, so the number of edges contributed by each hexagon is 6/2 = 3 and by each pentagon 5/2. Each pentagon or hexagon contributes one face. Let p be the number of pentagons and h the number of hexagons, then we have 2 = 2h + 5/3 p - 3h-5/2p + h + p = p/6 and thus p = 12.

Problem of the Week

This type of problem is classic. Over the recent Thanksgiving holiday there were four guests at my friend Linda's house, me, Josh, Sarah and John (names have been changed to protect the innocent). Linda had to run to the neighbor's house, so she asked the guests to take the turkey out of the oven. Upon return she found the turkey on the kitchen floor, ruined. When questioned by Linda, each guest made the following statement.

Me: "Josh did it."
Josh: "John did it."
Sarah: "I didn't do it."
John: "Josh is lying."

Assuming that exactly one guest is telling the truth, who did it?

*** Please submit all solutions by Wednesday at noon to Amelia Taylor by e-mail (ataylor@stolaf.edu) or by placing them in her box at OMH 201.

Adam F. McDougall – Problem Solver of the Week

***If you would like to receive a copy of the Math Mess in your P.O. Box weekly, please e-mail Donna Brakke at brakke@stolaf.edu.

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