NAG8-1198

Final Technical Report August 2004

Background

This project has suffered severely due to personnel situations. First, almost immediately after the start of the grant period, all the co-investigators left the Institute for Astronomy to start a private company specializing in adaptive optics applications. This left the PI with no technical people to work on this development. It was hoped initially that someone could be hired to take over the work, but no suitable person was found. The second significant personnel event was that the PI also left the Institute, to pursue an opportunity at Johns Hopkins Applied Physics Laboratory. This occurred in the fall of 2001.

Dr. Mickey has returned to the Institute from his leave, but the funding agency did not transfer control of the project to University of Hawaii personnel, so it was difficult to proceed with the research. In this situation, the Institute for Astronomy solar group found it necessary to concentrate on projects for which community interest was higher.

Technical Progress

A small amount of work has been done on this project; the strategy to be adopted has been better defined, though no experimental work has been started.

- Wavefront error signals: The best choice appears use a lenslet array at a pupil image to produce defocused image pairs for each subaperture. Then use the method proposed by Molodij et al. (2002) to produce subaperture curvature signals. Basically, this method samples a moderate number of locations in the image where the value of the image Laplacian is high, then taking the curvature signal from the difference of the Laplacians of the extrafocal images at those locations. The tip-tilt error is obtained from the temporal dependence of the first spatial derivatives of an in-focus image, at selected locations where these derivatives are significant. The wavefront tilt can be obtained from the full-aperture image.
- Extrafocal image generation: The important aspect here is to generate symmetrically defocused images, with dynamically adjustable defocus. The adjustment is needed because larger defocus is required before the feedback loop is closed, and at times when the seeing is worse. It may be that the usual membrane mirror is the best choice, though other options should be explored.
- Detector: Since the proposed sensor is to work on solar granulation, rather than a point source, an array detector for each subaperture is required. A fast CMOS camera such as that developed by the National Solar Observatory would be a satisfactory choice.
- Processing: Processing requirements have not been defined in detail, though significantly fewer operations per cycle are required than for a correlation tracker.

Final Technical Report - Education and Public Outreach
Grant: NAG8-1798
Curvature-Based Wavefront Sensor for Use on Extended, Arbitrary, Low-Contract Scenes

Barry Labonte's account (# 659999) provided some EPO support to related to solar research, in particular with respect to the Maui Facilities. We incorporated a solar component and focus on Maui in the final year of our 5-year TOPS workshop program using support from this grant.

Program Goals and Outcomes

The goal of the 5 summer workshops was to directly impact 30 in-service science and math teachers each year by

(1) Teaching them astronomy content which could be used in all science/math classrooms
(2) Providing teachers with new materials & resources as well as training them on how to write grants for their own resources
(3) Building a support network for the teachers
(4) Empowering the teachers to run secondary workshops so that they train other teachers
(5) Teaching the teachers how to align their classes with state and national standards
(6) Teaching modern evaluation processes.

Program

In our 5th and final workshop year we offered a more focussed program which began on Oahu. The goal of year 5 was to take only returning teachers who had learned the content and observing skills on small telescopes and to train them to become master teachers to make use of the new Faulkes Educational Telescope facility which was to come on line by Summer 2004. The Faulkes Telescope -- The Faulkes telescope is a partnership between the Faulkes corporation in the UK (http://faulkes1.astro.cf.ac.uk/ and http://166.122.72.30/faulkes/intro.html) which has built a 2-meter research grade telescope on the summit of Haleakala Maui for the exclusive use of outreach. Hawaii teachers and students will have shared access to the telescope time. While Hawaii was focusing on construction and development of the telescope, there was no equivalent development of an educational plan, yet we had a large number of teachers in our program who had the content background to become the first core set of users and could be master teachers for future training.

Summer 2004 Hawaii teacher workshop Goals: Train teachers to be able to mentor students in the planning for remote observing with a 2-m class telescope, execution of observations, and analysis of the data. We received laptop computer donations so that each teacher was able to have the tools necessary for this project to keep with them throughout the year. During the course of the program, which was held from June 10-21, 2003, we trained the teachers in research activities on a variety of projects, including those that involved solar data. In addition, at the end of the workshop, the teachers were given a tour of the Haleakala facilites, and then planned and conducted a 1 day secondary workshop on Maui for local teachers.

Five year Accomplishments

Summary

Workshops
- Second Tier teacher workshops (1999-2003) - 1246 participant hours
- Pacific Island workshops (1999-2003) - 1280 participant hours
- National workshops (1999-2003) - 406 participant hours

Student impact
- Micronesian Astronomy clubs formed (Kosrae, Pohnpei, Yap, Marshall Islands, Palau)
- Instructional innovations (new astronomy courses and content)
- TOPS students participate in international AAVSO conference 2001
- International AAVSO meeting partners with TOPS, Kona Hawaii 2002
- Strong showing in 2004 Hawaii Science fair

TOPS TEACHER WORKSHOPS - 2nd Tier - Hawaii
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1. HI Science Teachers Assn Conf - 1999 - 2002
   4 x 40 teachers x 2 hour = 320 participant-hours

2. HI State Teachers Assn Institute, 10/99,00,01,02
   4 x 30 teach x 1 hr x 2 sessions = 240 teacher-hrs

3. Windward Community College
   10/00 Astronomy - 30 teach x 4 hr = 120
   2/02 TOPS & NASA - 20 teach x 4 hr = 80

4. Maui TOPS Workshop - 6/28/03
   18 teach x 7 hrs = 126 participant-hrs.

5. Lacy Veach Day (astronaut), Nov. 01, 02, 03
   10 teach x 2 hr x 3 yr = 60 participant-hrs

6. TOPS Maui Teacher workshop June 28, 2003
   50 teachers x 6 hrs = 300 participant-hrs

TOTAL = 1246 part-hrs.

Pacific Islands - It was very difficult to get teachers to feel confident to run a second-tier workshop. This was a first experience for most of them.

1. Pohnpei Ministry of Educ -C. Soram (01,02)
   30 teachers x 4 hrs.x 2 yrs = 240 part-hr.

2. Rota Ministry of Educ - K.Woolslayer(99,00)
   15 teach x 2 hrs x 2 yrs = 60 part-hr

3. Yap Ministry of Educ - Irene Fajardo (99,01)
   20 teach x 2 hrs x 2 yrs = 80 part-hrs

4. University of Guam - Rick Seidel (00)
   10 teach x 3 hrs x 1 yr = 30 part-hrs.

5. Kosrae Ministry of Educ - Mixon Jonas (01)
   15 teach x 2 hr x 1 yr = 30 participant-hrs.

6. Micronesia TOPS Workshop July 27-30, 2003, C. Soram/TOPS staff, Pohnpei, FSM
   30 teach x 7 hr/day x 4 days = 840 part-hrs.

TOTAL = 1280 participant-hrs

NATIONAL/INTERNATIONAL ACTIVITIES

1. National Science Teachers Assn Conf Mar, 2003, Philadelphia, PA
   - 2 sessions x 40 teachers x 1 hr = 80 participant hours
   Apr, 2004, Atlanta, GA
   - 3 sessions x 30 teachers x 1 hr = 90 participant hours

2. American Assn of Physics Teachers Conference
   Jan, 2003 - Austin, TX "TOPS Telescope Projects"
   Aug, 2003 - Madison, WI "Astrobiology Projects"
   Jan, 2004 - Miami, FL "Telescope" workshop
   10 teachers x 4 hrs = 40 participant-hrs.

3. Amer Assn of Variable Star Observers AAVSO Conference, July, 2002, Kona HI
   20 TOPS teachers and students performed play for
   20 minutes, did 6 presentations to amateur & professional astronomers.
   - Student presentations: Serena Dameron, Nicholas Bradley, Melissa Ferreira

4. Amer Astronomical Soc. Division of Planetary Sci. Conf., Monterey, CA
   - 3 TOPS teachers did presentation about Faulkes telescope and teacher participation for the Deep Impact mission at Deep Impact workshop
   - 3 TOPS teachers did presentations for 15 CA Teachers
     3 teachers x 2 hours = 6 participant-hr
     15 teachers x 1 hour = 15 participant-hr

5. TOPS Staff workshop at Pacific Education Conferences
   - Palau (2000) - 15 teachers x 3 hrs = 45 participant-hr
     night observing 100 participant-hr
   - Guam (2001) - 15 teachers x 2 hrs = 30 participant-hr

TOTAL = 406 participant-hrs

STUDENT IMPACT

Astronomy Clubs Formed

1. Pohnpei, Federated States of Micronesia (FSM) Cassiano Soram (2000-2002)
2. Kosrae High School, Kosrae, FSM Mixon Jonas (2000), Jacob Lonno
3. Melam Elementary School, Kosrae, FSM (Mixon Jonas became vice principal)
4. Yap High School, Yap (2002) Lilia Dela Madrid, Lisa Nuestro
5. Marshall Island High School, (2002) Glenn Fernandez, Lucky Lucky
6. Palau High School, (2002) Juliet Ngotel
   Participant hours not yet documented.

Classroom Instruction Innovations - shown by Teacher portfolios (samples)

1. Start astronomy course -
   Tom Chun - Kamehameha School
   Cassiano Soram - Pohnpei Central School

2. Integration of Astronomy into Course
   - Victor Kim - Use of planetary orbits & Mars topography in geometry class
   - Jean Hamai - Variable star light curves integrated into algebra class
   - Sophie Hu - Integrate study of moon, celestial sphere & astrobiology into biology class

TOPS Science Fair Projects 2004

Intel International Science & Engineering Fair Entry
Jenna Dionisio (10th) (Kalaheo High) - "Extrasolar Planet" project
TOPS Teacher Sharon Price

Chevron State Science Teacher of the Year
Jeffrey Giacobetti, TOPS Teacher (02,03) - won trip to IISEF in Portland, OR, based on his active role in advising student science fair projects

Mar, 2004 - Hawaii State Sci & Eng Fair (HSSEF)
-Sharon Price, Jenna Dionisio (10th) (Kalaheo High)
1. Extrasolar Planet project Windward School District 1st place
-Sophia Hu, (McKinley High)
2. "Variable Star FU Orionis" - Helen Park and Jung Hee Lee (10th)
3. "Retrograde Motion of Mars" - Daniel Shimura (9th)
-Jean Hamai, Math teacher (Kamehameha School, Maui)*
4. "Light Curves of VV_Uma and RU_Umi" - Kalani Rosell
Recommended - HI Sci and Eng Fair
*Native Hawaiian focus

Other Science Fairs
- Rosa Hemphill, Oregon Episcopal School
5. "How Does V380 Ori Vary?" - Jenny Wolochow (10th)
Oregon Jr. Academy of Science Invited to AAVSO Conf, Berkeley, 7/04
- Pebble Richwine, Ironwood Ridge High
6. "Variable Stars" - Nancy Hankel, 10th
2nd place at school fair, entered Regional Fair

Elementary School Science Fair - Hawaii
- Jeff Giacobetti, Gifted & Talented teacher
7. "Ka Mahina" (The Moon) - Kiana Lemelle, 4th grade
Display board in Hawaiian, report in English
Hau'ula El. Science Fair - 2nd Place,
Kahuku Complex Science Fair - Honor. Mention
8. "Sunspots" - Ku'ualoha Lemelle, 5th
Hau'ula El. Science Fair - Honorable Mention
9. "Mars Rovers" John Ginella, Edmund Graves, 6th
Sunset Beach Elementary School Fair entry

New Professional-Amateur-Teacher Collaborations

Science Fair 2005 - Faculty mentors
Roberto Mendez (IfA) - Variable Stars
Jeffrey Kuhn (IfA) - Sunspots and Sun
Kent Culler (SETI) - Sun (for Blind student)
Tim Castellano (ARC) - Extrasolar Planets
Karen Meech (IfA) - Comets
Science Fair 2005 - Amateur mentors
James Bedient - Variable Stars
Ken Archer - Personal Dome Observatory

Special Teacher mentions - Elementary participation

1. Jeffrey Giacobetti (Science Resource Teacher) (TOPS 2002, 2003)
   - Doing Starlab (portable planetarium) shows for 350 students at 3 schools, and also for parents the past 2 years. Trained at TOPS program.
   - Manages Science Fairs at Hau'ula, Kaa'awa, and Sunset Beach Elementary Schools and mentors over 60 students for astronomy projects. Best projects will be on display at UH IfA Open House, 4/18

2. Alyce Ikeoka (TOPS 1999-2003)
   Lanakila Elementary School focus on Hawaiiana Culture and Arc heoastronomy working with Rubelite Johnson,UH Prof Emeritus Since 1995, 4th Grade Annual Star Party for students and parents with HI Astronomical Society members bringing telescopes and TOPS students assisting and Amer Assn of Physics Teacher HI Section member doing optics/telescope activities.

3. Beth King-Mock - Honolulu District Special Ed Resource Teacher (TOPS '02-03)
   Mentoring Rylan Suehiro (6th), going blind, Kawananakoa Middle School on "Solar Rotation" project, got Kent Cullers from SETI as mentor for his Braille report. Want to send this TOPS teacher to NASA Special Needs workshop, 7/18-22/04, Univ. of Wash in Seattle, so she can mentor more SPED students.