Algorithm for Real-Time Parallax Correction

This is your secure and confidential Project Room for the Challenge. From here, you can receive the Challenge details, submit your solution proposal, ask questions, and receive answers confidentially from the InnoCentive team.

Algorithm for Real-Time Parallax Correction

AWARD: **$50,000 USD** | DEADLINE: **2/29/16** | ACTIVE SOLVERS: 26 | POSTED: 1/27/16

Source: InnoCentive **Challenge ID:** 9933759 **Type:** RTP

Team Share 1 Messages Agreement

Detailed Description & Requirements

Background

Military optical systems increasingly consist of multiple image sensors in various frequency spectrums. Camera apertures displaced radially from the eye result in parallax, causing an imaged object to appear displaced to the viewer. This effect becomes dramatic as the viewed object becomes closer to the observer. A simple example would be a sports camera mounted on a skier's helmet. The video will be similar, but not exactly the same as the skier's perspective with objects being shifted more, the closer they are to the camera. For a head-mounted imager to be operationally useful, parallax correction of the sensor images must occur automatically, in real-time, with a minimum amount of latency. The view from the offset camera must be changed to what the view would be from the subject's eye.

Current Status

To date, our market research indicates that no commercial solution exists. Implementing camera-based eye tracking (e.g. Tobii,) to determine eye convergence distance has previously been demonstrated and has shown several shortcomings. The greatest are:

- Lack of resolution at distances greater than 30m
- Need for repetitive "calibration" due to user/environmental changes within a mission timeline.

An eye-tracking solution is not eligible for prize award unless the listed shortcomings have been overcome and are not noticeable to a non-scientific user.

There has also been work done using a rangefinder to determine distance first then make the correction, but this system is much too slow for the application. Solvers should assume that Rangefinder data will NOT be available to the operator.

The Seeker is aware of Lytro's light field cameras that can be refocused. It is not off limits, however just mentioning it is not considered a solution. So far, they have not shown promise.

The Challenge

The Seeker would like to find parallax correction system based on an algorithm that can correct for parallax error in near real time for sensor images. The ideal solution would provide accurate parallax correction of two helmet-mounted, visible-light sensors and display the results to the operator in near real time. The resultant image will permit the operator to perceive the location and direction of objects sufficiently to freely navigate in an object-cluttered room (roughly 30' x 30'), locate and grasp stationary objects, and manipulate designated switches and controls. The parallax correction system should operate with no more than 20ms of latency.

Demonstration would be to take the view (sensor data) from position A and transform it into the data seen at position B of an identical sensor. The transformed "position A" data should match the view (sensor data) at position B. The relative positions of A and B in 3D space would be known. Position B would be the "subject's view".

(**NOTE:** the **Technical Requirements** below are given for both Phases I and II so the Solvers know the ultimate goal of the Challenge. Some will be accomplished in Phase I and some in Phase II. The Deliverables below will tell Solvers what needs to be delivered for each Phase.)

The proposed algorithm/system should meet the following **Technical Requirements**:

1. The algorithm/system shall provide parallax correction in near real time (<20 ms latency) for images from a helmet mounted visible light sensor and display the results to the operator.
2. The resultant image will permit the operator to perceive the location and direction of objects sufficiently to freely navigate in an object-cluttered room (roughly 30' x 30'), locate and grasp stationary objects, and manipulate designated switches and controls.
3. The preferred solution provides for cameras to be placed (for perspective determination) above the eyebrow and shifted out from the centerline of the head (wide field of view; both horizontal and vertical parallax correction). An acceptable solution provides for camera locations above the eyebrows and vertically aligned with the eye (center field; vertical parallax correction only).
4. A commercial virtual reality headset (e.g., Oculus Rift, HTC, Sony, Samsung) may be used to demonstrate the system's performance. Cameras used for the demonstration should provide a minimum image resolution of 640x480 and minimum frame rate of 60Hz. Some equipment will be available from the Seeker, however, the Solver will be responsible for any failures due to incompatibilities of equipment. It will be best to provide your own equipment.
5. Processing power for the solution is constrained to the computing and storage capacity commensurate for combat-carry (e.g., high-performance tablet, Android phone, or similar mobile devices). Therefore the

Submit Solution

Your profile is 61% complete

Solver Agreements

These are the Solver Agreements you have signed for this Challenge.

- Solver Terms of Use
- Challenge-Specific Agreement

Share This Challenge

Like Share 0

Tweet

Share 1

+1 Recommend this on Google

Challenge Data (What's This?)

Solvers

Submissions

Solver Map

Information for Academics

If you are a US University or College Professor, student (graduate student or undergraduate), or you work at a similar type of institution...

- Click Here for Important Info.

parallax-correcting algorithm must be coded as efficiently as possible.

6. The parallax correction software algorithm and related code must be transportable to operate on an operating system compatible with the Xen Hypervisor (Linux).
7. Rangefinder data will NOT be available to the operator.
8. The proposed system should offer the Seeker client "freedom to practice". There should be no third party patent art preventing the use of specific software, equipment and materials for their commercial application.

If multiple proposals meet all the **Solution Requirements**, the Seeker reserves the right to award only the solution which they believe is most likely to be successfully and cost-effectively implemented.

Project Criteria

The submission to the Challenge should include the following:

Phase I:

1. A detailed description of the proposed algorithm/system addressing specific **Technical Requirements** presented in the Detailed Description of the Challenge.
2. Rationale as to why the Solver believes that the proposed algorithm/system works as presented. This should include the code as well. Solvers are not required to provide proof at this time; however they should provide it, if available. The goal of this rationale is to convince the Seeker that the solution is viable and is worth bringing to Phase II. You cannot provide too much evidence.
3. Parallax Correction software algorithm in code that runs on an operating system compatible with the Xen Hypervisor (Linux, Android, Windows). Preferred coding languages are C++ and Java.
4. Narrative software description and user guide
5. Developmental test protocols and any results to date.
6. Narrative describing any known performance limitations and other shortfalls.
7. Mitigating actions and proposed long-term solutions.
8. If available, provide images that have been corrected for parallax.

Submissions to Phase I of this Challenge must be received by 11:59 PM (US Eastern Time) on February 29, 2016. Late submissions will not be considered.

Phase II: (Note: the timing of Phase II will be determined at the end of Phase I. Phase II will be approximately 8 weeks.) The live testing phase will take place in the Tampa, Florida area. Solvers will be responsible for their own transportation and arrangements. More Details will be provided at the conclusion of Phase I.

1. Before the testing on Phase II, any code will have to be run on an operating system compatible with the Xen Hypervisor (Linux). The Seeker will try to accommodate Solvers, but if the software cannot be run, it cannot be evaluated or awarded. Solvers will be responsible for incompatibility problems.
2. A live demonstration on a commercial virtual reality headset (e.g., Oculus Rift, HTC, Sony, Samsung) may be used to demonstrate the system's performance. Cameras used for the demonstration should provide a minimum image resolution of 640x480 and minimum frame rate of 60Hz.

A judging panel will be assembled for Phase II demonstrations and they will have access to recordings and wearers surveys. The Seeker will provide test subjects and the test course.

The proposal should not include any personal identifying information (name, username, company, address, phone, email, personal website, resume, etc.)

The Challenge will take place in two Phases:

Phase I - will be a theoretical written phase which will require an algorithm and explanation along with any backup data. Those awarded in Phase I will be invited to Phase II.

Phase II will be an on-site field test for the algorithms and systems from Phase I. Solvers will be responsible for attending the site test.

The total potential award pool is $50,000.

Phase I Awards - $2000 for each submission invited to compete in Phase II (max = 5)

Phase II Awards – (Awarded if requirements are met)

$20,000	1st
$10,000	2nd
$ 5,000	3rd

The awards are contingent upon theoretical evaluation and experimental validation of the submitted solutions by the Seeker and their judges. The Seeker's decisions will be final.

To receive an award, the Solvers will NOT have to transfer to the Seeker their exclusive Intellectual Property (IP) rights to the solution. The Solvers will provide a perpetual, non-exclusive government use license (see Challenge Specific Agreement for details). Solvers will be allowed and encouraged to commercialize their work. Continuation of collaboration with the Seeker (although not guaranteed) is possible at the conclusion of the Challenge.

Submissions to this Challenge must be received by 11:59 PM (US Eastern Time) on February 29, 2016. Late submissions will not be considered.

Additional Information

- Frequently asked questions

Challenge Attachments

There are no attachments for this Challenge.

About the Seeker:

U.S. Special Operations Command's (USSOCOM) mission to provide trained, equipped, ready, and regionally aligned special operations forces (SOF) in support of Geographic Combatant Commanders, and through unified action, to conduct sustained special operations to eliminate threats to U.S. interests and protect the American people.

The SOF Acquisition, Technology, and Logistics Center (SOF AT&L) within USSOCOM is purpose-organized to deliver capability to SOF users expeditiously; exploit proven techniques and methods; keep Warfighters involved throughout the process, and to recognize and manage the associated technology development and resource investment risks. The Center oversees a portfolio of about 500 acquisition programs and development projects, and awarded $3 billion dollars in contracts in 2014.