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Holographic storage

I wish to contact Pavel Cheben or his company to gain information about the holographic storage disk he has developed (August/September, p. 11). My company, Difinity Inc., has aerospace applications for this product. We are also looking for a material for deep-space containers. It must be resistant to extreme heat and cold, ballistically strong, radiation-hard, and lightweight. Can you recommend a product and its manufacturer?

Jan Naftulin
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[Search Optenia on the Web; maybe readers can suggest materials.—*Ed.*]

Color demo

I tried your demonstration ("Color Documents in the Internet Era," June/July, p. 18), which dramatically improved the accuracy of the color images. How do I obtain the gamma values of my monitor to make this improvement permanent?

Brendan Godfrey
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[*Author replies*: There are actually two parts to your question. The first is extracting the gamma value. One possibility is for you to send me a screen shot (tif or jpg) with the window containing the three gamma targets and with the sliders at the positions where the matches occur. From this information I can send you approximate gamma values for the red, green, and blue channels. The second, and more complex issue, is what do you do with these gamma values?

There are two requirements for getting the color right on the display: (1) the image must be calibrated (this means that the image is prepared to look "right" on some display with known characteristics), and (2) the display must be calibrated. At this point, the interactive tool we provided only performs the second step of display calibration. We took care of the first step offline by pre-calibrating the two specific demo images to a gamma value of 1. Correcting arbitrary images takes some additional work, since the gamma information about the image somehow needs to be extracted or assumed. In a few cases, this information is specified within the image file via tags.

In summary, we can retrieve the gamma values for your display, but I'm sensitizing you to the issues that must be dealt with to use this information correctly.

Raja Balasubramanian]

Are printed versions of the Web match chart available from your article in *The Industrial Physicist*? I am helping a group pull together a value-added wood products cooperative that will sell highly figured wood to

BPA INTERNATIONAL

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serious woodworkers and artisans over the Internet. We need a way to control colors so that a buyer can see an accurate representation of each product being offered for sale. The easiest way to do this is to include a reference color chart in every image (the images will be acquired using a high-resolution digital camera) and provide an associated software package. In addition to monitor calibration, we have to deal with lighting temperature. Because images are likely to be acquired in the field (from, say, 6 a.m. to 8 p.m. during the summer, under highly variable background lighting), we expect to see color temperature shifts induced by background lighting. The third problem is moisture control. As you may know, wet (or finished) wood has a different color from dry wood. Because virtually all of our wood items are finished, each board will be misted with a water/alcohol mixture just prior to imaging.

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[*Author replies*: A chart from a magazine print will not necessarily help. The demo in *The Industrial Physicist* required the chart because we were trying to match the display to the magazine print. You will, however, need a target for calibrating the digital camera, and some form of color matching software to correct for each buyer's display. The software and target we used for the demo are not currently available as products for commercial use. I can, however, give you some references to resources that might help you carry out your project.

For the calibration target, I refer you to GretagMacbeth (www.gretagmacbeth.com), which supplies the Color Checker DC target designed specifically for digital camera calibration. This chart contains some reference gray patches. If the digital camera image of this target is adjusted until these patches look gray on a calibrated display, you will likely have adjusted for illumination effects (to a first order). GretagMacbeth mentions supplying software for calibrating the digital camera based on this target. Another product for Internet-based display calibration that you might find useful can be found at www.ecolor.com.

The tool we built for our interactive demo uses fairly standard techniques for visual display calibration. We implemented it as a Java applet so that users could do the demo with only a Web browser. If you have experienced programmers on your staff, you might build something like this in-house.

Raja Balasubramanian]

Maglev launch

I am writing in response to Robert Lacombe's letter on launching spacecraft using maglev technology (August/September, p. 6). I am a strong advocate of space travel and have pushed electromagnetic launching of spacecraft for more than 20 years, ever since my company, Westinghouse, showed that electromagnetic devices could easily replace steam catapults on aircraft carriers for launching planes.

Even though this is a demonstrated technology for aircraft weighing several tons, which is significantly more than the upper stages of many spacecraft, I have never had a positive expression of interest from the National Aeronautics and Space Administration (NASA), The Planetary Society (of which I am a member), or other space advocacy groups. Note that here I am speaking of open-air and relatively simple electromagnetic launchers, since maglev technology is more than is needed for this problem, and here's why.

In his letter, Lacombe did a calculation for using maglev to reach escape velocity. However, it just plain wouldn't work. Consider for a moment what would happen to any manmade object encountering sea-level atmosphere at 25,000 mph. Basically, you would have an inverted meteorite that would be molten metal in 1,000 yards. So a maglev ground-to-space system is not practical.

Consider instead the fact that at least 90% of the initial launch weight of a spacecraft is in the first stage, which is burned up and dropped at not too great an altitude and velocity. By comparison, launching by using the "wall-plug power" of an electromagnetic launcher would cost 20% as much or less if it could achieve a vertical subsonic velocity before a second-stage conventional rocket took over. And of course, even a conventional electromagnetic launcher could achieve those velocities and use only a quarter- to half-mile of track; the greatest problem would be converting from horizontal to vertical by using a track with a curvature that could take the force against it of the accelerating spacecraft (on a reuseable cart with parachute), and not require too great a vertical height to be impractical.

As to second stage and greater, the Westinghouse NERVA rocket engines reached, as I remember, something like 60,000 lb of thrust for periods of several minutes—far more than needed to move most spacecraft into orbit and beyond after the first stage is used up. Once a craft is in orbit or leaving Earth's gravity, various ion engines with sufficient specific impulse and fuel could carry on from there. The biggest problem is getting past the environmentalists and their overreaction against the word nuclear.

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[*Author replies*: I must agree with you about sea-level launches of payloads destined for orbit. At a very minimum, you would need ablative shields on the craft similar to those on the Space Shuttle, and even then you would be launching some pretty hot rockets, to say nothing of the attendant sonic boom. There probably is no spot in the lower 48 states that would let you set up such a launch facility. Your idea of using maglev for the initial booster stage makes the most sense. I wonder why NASA isn't picking up on the idea. Quite likely a case of "not invented here."

Robert Lacombe]

Robert Lacombe's letter seemed to be a little out of touch. May I suggest a visit to www.SSI.org (the Space Studies Institute) for the details of the mass driver project? It has been quite a few years since I read the report, but I seem to remember that one of the first projects funded was an investigation into, and the construction of, the first few elements of a superconducting mass driver. Results were better than expected, with an acceleration of more than 3,500*g*, giving a launch structure length of around one mile for orbit and a lunar launcher length of about two space-shuttle bays. Obviously, this is not useful for living tissue, but it works fine for food, oxygen, fuel, steel, structural components, and radioactive waste material. Other details included a telephone-pole-shaped launch vehicle weighing about 1,000 lb, of which 300 lb would be ablative shielding for the trip through the atmosphere. The driver had an open structure accelerator rather than an evacuated tunnel, to allow pressure waves to expand. The economic analysis assumed launching one of these every 3 min and required a dedicated 1,000-MW power plant to run the driver.

The final numbers indicated that the facility was not economic with the liquid helium superconducting coils then available, but that it would be profitable when high-power, high-temperature (liquid nitrogen) superconducting coils became available. Last year, Detroit Edison became the first utility to put a "high-temperature" superconducting power line in service.

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[*Authors reply*: We share the frustration with today's clumsy rocketry. A hybrid approach might work as an evolutionary step in launch technology. Our paper ("The Evolution of Transport," April/May, pp. 20–24) looked 100 years ahead, so we ventured daring proposals. We are fully aware of the problem of the meteorite in reverse. A curved half-mile track offers one hint for the inventors of better launch systems—-the projectile should leave Earth quite high. Why not extend the vision and lean the ramp for a vacuum maglev launcher on a high mountain, so that the first air encountered is already thin? Launching at sea level makes no sense. A complementary proposal involves a traveling "air spike" to ease the way (*Aviation Week and Space Technology,* May 15, 1995, pp. 66–67). Use microwaves or other forms of directed energy to hollow out a paraboloid pocket of low-density, low-pressure hot air at the front of the vehicle to reduce drag and heat-transfer effects. Such cavitation schemes offer industrial physicists good problems to solve, in water as well as air.

Jesse Ausubel and Cesare Marchetti] Ω