



By Joseph H. Bell, LS

Joe Bell is licensed in California and New Mexico. He has been reviewing software for surveyors since 1982.

Adapx Digital Pen and Capturx for ArcGIS

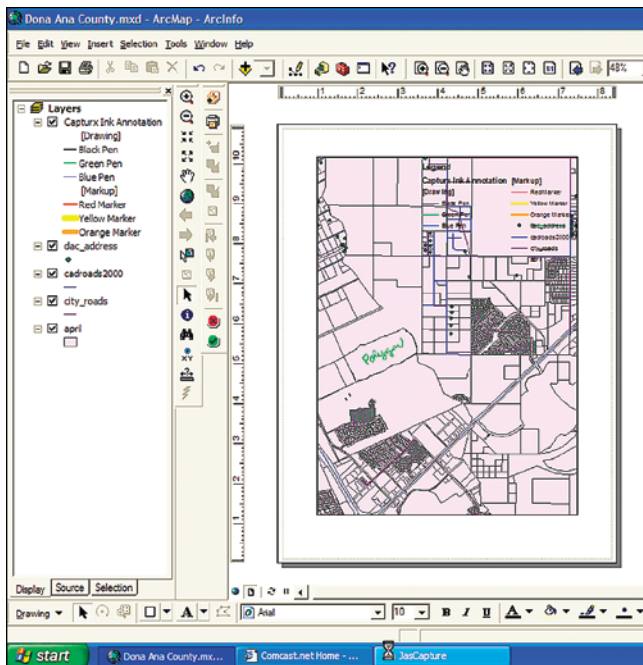


Figure 1

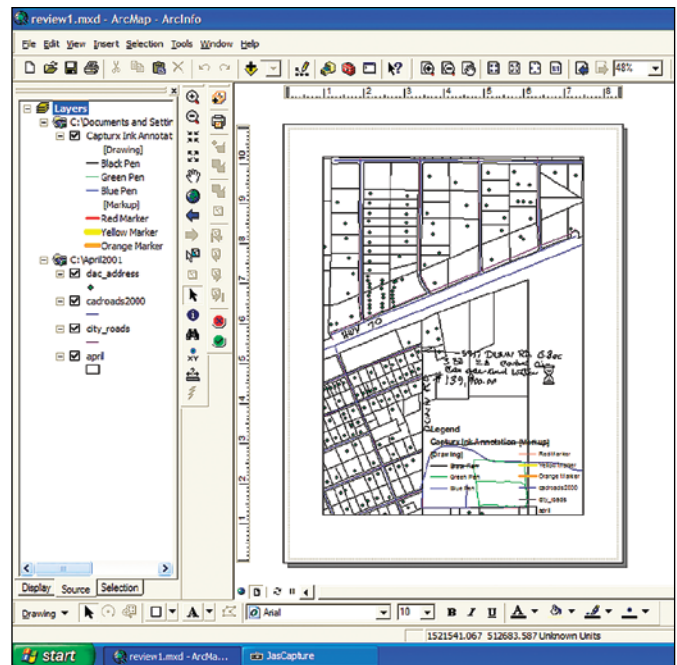


Figure 2

It all started with Dick Tracy and his radio wrist watch. Now we have a pen that is a data collector. The Adapx digital pen is both Bluetooth-enabled and a USB device. The pen weighs just over an ounce and is about the size of an average ballpoint pen. Communication is either USB 1.1 standard, USB 2.0 standard, or Bluetooth 1.2 standard. It operates in temperatures from 32 to 104 degrees Fahrenheit. On standby the lithium-ion rechargeable battery lasts up to ten days between charges (if the cap on the pen is off, the unit is on standby). When in use the pen will operate for four hours or

longer and store up to 50 pages between transfers. Charging in the cradle takes two and a half hours.

The potential uses for such a pen are huge. For surveyors and map makers, let's start with making field notes on an ArcMAP. Using the pen, notes can be written directly on the map. These notes become data that can be transferred by Blue Tooth or by inserting the pen into a USB cradle. Once the data is transferred it creates its own layers and puts all of the data directly on the ArcMAP in the computer. The field person can draw polygons, arcs and points in layers the same as in ArcGIS. Freehand annotation may also be added.

How does it work? The ArcMAP has to be printed with a postscript printer (in this case an inexpensive OKI C6150). Holding the map up to the light, the edges of the map appear slightly grayish. What you see is a very precise Anoto grid pattern. When you write on the map, the pen actually reads the points on the grid and stores them in memory. When you transfer the data, the pen puts the data on the layer you created with the colors you have created, and stores the memorized points on the correct layer. The data now becomes part of the original map. Now your data is the same structure as the normal ArcGIS layers and can be

UPDATING THE GEODATABASE WITH PEN STROKES VIRTUAL INK FOR GIS SPEEDS MOBILE GEODATA COLLECTION

Writing things down is a powerful form of expression going back thousands of years. For field engineers accustomed to gathering around a paper map and penciling annotations, bridging the gap between digital and tangible seemed a distant dream until recently. Last year, Freese and Nichols, a Texas-based engineering firm, integrated the use of virtual ink for GIS into its field operations and achieved significant time and cost savings as a result.

In many cases, field staff at Freese and Nichols collaborate on a single map sheet on-site to develop the exact plan of action for a project. Although a common feature of mobile field work, this huddle-and-scrrawl method has its pitfalls. Critical data written on these paper maps often must wait to be entered into the geodatabase back at the office, introducing critical time lag as well as posing the risk of errors in the data entry process. In addition, the collaborative aspect of multiple-engineer data collection is all but lost as soon as the data gets back to the central database. Having recently been tapped to develop a 20-year master plan for Texas A&M University and provide structural engineering for a proposed music hall for the University of North Texas, Freese and Nichols needed a more efficient solution for its mobile data collection practices.

"We have a high volume of geospatial information that we must collect in the field for our projects," says Mark Valentino, GIS coordinator for Freese and Nichols. "Performing sketches on large paper maps and then manually transcribing the data back at the office was an inefficient means of updating the database." Freese and Nichols needed to eliminate the gap between the time the data was collected and brought back to the central database; however, such a solution seemed like a tall order for even the most cutting-edge mobile data collection firms. The biggest hurdle seemed to be engineers' dependence on huddling around the paper map to decide what goes where. Was it possible to wean field staff from their use of paper and pen in the field? Given their dependence on this tried and true method, the answer was a clamorous NO.

In 1998, researchers David McGee and Phillip Cohen conducted observations of field crew work practices that convinced them the pencil wasn't going away. With this simple acknowledgment, both men founded Natural Interaction Systems LLC (later to become Adapx) and soon began development on a digital paper and pen-based platform to update the geodatabase. In 2007, Freese and Nichols learned that the platform, now called Capturx for ArcGIS Desktop, was in the testing phase. The engineering firm leapt at the chance to be a part of it and has been successfully using the platform in the field ever since.

Here's how Capturx for ArcGIS works: ordinary paper printed, or "watermarked," with a series of dots (called an Anoto pattern) allows the digital pen to determine its location on the map like coordinates on a globe. Together, the pen and paper can be used to specify the type of features to be captured as well as attributes for those features. Each successive click of the pen records the items to be added to the digital version of the same map. When the pen is docked into the USB port on a PC or laptop, notes are immediately available and can be accessed with no additional assimilation work or gatekeeper involvement. Using ArcGIS, the field engineer can check out the latest GIS data, edit it on-site, and post changes back to the central database in an instant.

"The pen converts handwritten forms, field journal notes, sketching, and comments on maps and satellite images into digital data," says Adapx CEO Ken Schneider. "Although it looks and feels like a regular ballpoint pen, it contains an integrated digital camera, an advanced image microprocessor, and a mobile communications device for wireless connection. As mobile staff write, the digital pen takes snapshots of their writing in conjunction with a printed pattern, capturing and processing everything that is written. This speeds turnaround time by fully integrating a business process that end users already know."

Field engineers at Freese and Nichols are excited about the virtual ink solution, which has kept the collaborative environment intact while reducing the time and risk that traditional data entry involves. "With the Adapx solution, we don't change our practice of collecting data," says Valentino. "Data collection continues on-site and completely eliminates the reentering of information written and sketched on paper maps. It also preserves the collaboration of our engineers by distinguishing between the different user's digital pen once the digital ink is uploaded into ArcGIS."

Adapx digital paper and pen technology reflects a growing trend in IT: the incorporation of multimodal interfaces into the workplace. Behind this school of thought is the bold idea that users needn't necessarily change; oftentimes existing modalities, such as writing and speech, can be seamlessly adapted to proven systems.

manipulated in the same way with the ordinary ArcGIS commands.

Figure 1 shows the creation of a new polygon on the county map. To be a polygon, the figure must close. Under the legend you can see an arc in red. An arc is any line that does not close. In other words, is not a polygon. To the right of the polygon are several lots on which there are house symbols. The exact location is the first place the pen touches the paper. Any symbol you choose may represent the dwelling. On the left side is a list of layers that you can turn on or off. To the right of this list are the usual ArcGIS icons and to the right of those are the icons of Capturx (pronounced *CAPchurz*) software. (Capturx is integrated into ArcGIS software and works seamlessly within that application.) The Capturx icons allow you to add a new layer, print the layout, import the next session (unload a page of the pen), open the Session Dialog Box, select all Capturx features, clear all selected features, select the first change, select the previous change, select the next change, select the last change, reject all changes, or accept all changes. In talking with the folks at Adapx I learned that although the pen is already bluetooth-enabled, this functionality will not be added to the Capturx software until the fourth quarter of this year.

Figure 2 shows the map as modified with notes on the house at 5917 Dunn Road and the sale details for the house. (This makes Capturx useful to realtors who have access to ArcGIS). Objects such as fire houses and schools can also be located). Using the legend you can pick the type of figure you will draw, the color of your pen, and you can select one or more layers for annotation in different colors. The field inspectors can add missing houses, road extensions, or other notes. All the field notes become part of the original map. **Figure 3** is a page from the field book translated straight into the computer.

The possible uses of this book are unlimited: mileage, time on job, hard copy of requests which potentially become change orders, etc. Not only is it useful in the field but it can be used to keep appointments, expenses, etc. in office. The uses stretch to other fields such as nuclear medicine, office medicine, law offices, courts, accounting firms, expense records for salesmen, inventories, etc.

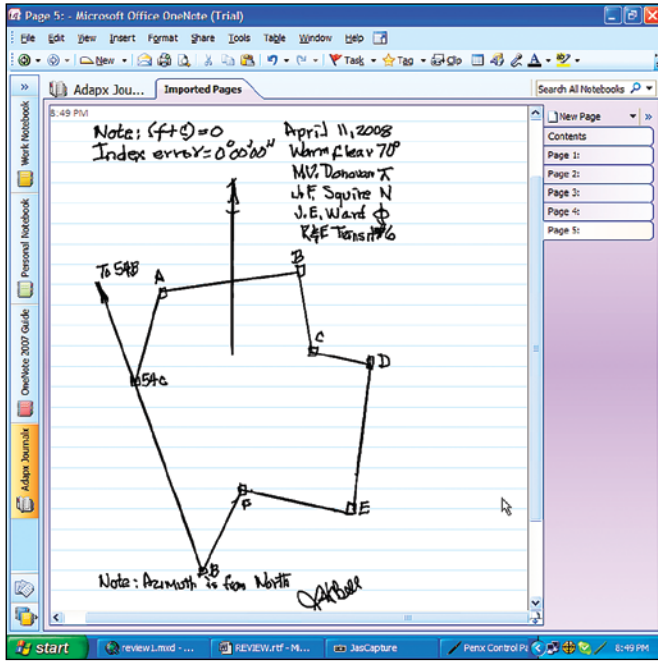


Figure 3

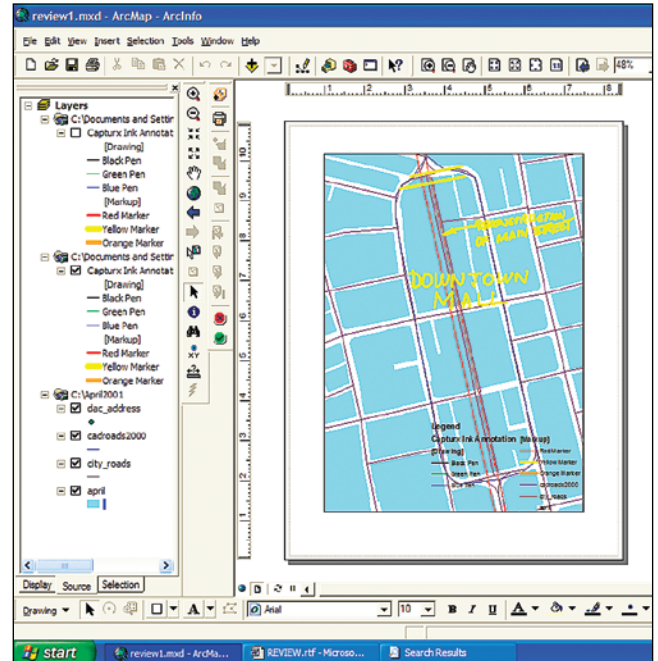


Figure 4

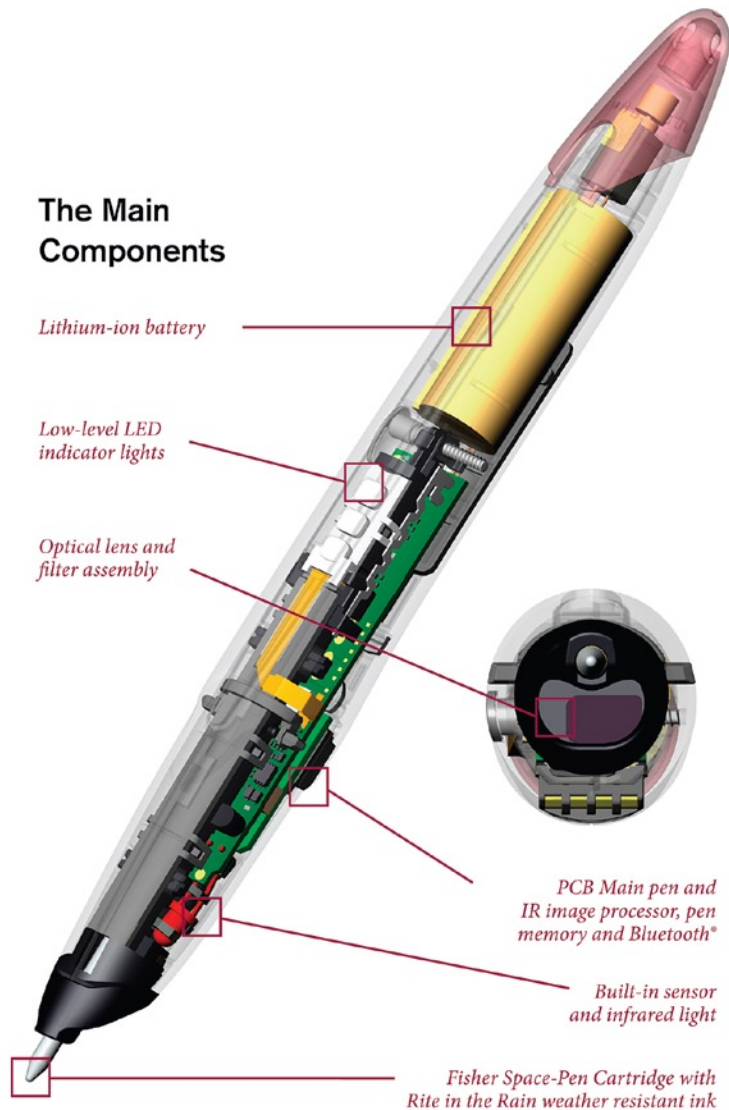
You can keep any sort of notes or lists in any of the Microsoft Office programs. For surveyors, it can replace the standard field book, providing both hard copy *and* data transferred to the computer.

Figure 4 shows a planning map for downtown Las Cruces. In the past, Main Street was blocked off to become the Downtown Mall. The city is planning to reopen Main Street so that all of the stores, theaters, etc. will have frontage on Main Street. The planning is taking place with the computerized pen. Proposed changes can be erased and new changes made. Planners, utility companies, police, fire departments and businesses can all work on the same drawing. Field inspectors can search for items missing from the map, and engineers can send a crew to the exact location where missing items were found.

Offered by Adapx is a special large-format field book already imprinted with the Anoto pattern. For the surveyor, this replaces the standard field book. Microsoft Office OneNote 2007 can be used to manage the field notes. Because it utilizes Blue Tooth, the data can be transferred back to the office by cell phone in total or a piece at a time.


By the time you read this, there should be an even more interesting use. You should be able to take a site survey or a construction plan into the field and make notes on it. From my own experience I can tell you that it pays to

The Main Components



check the construction plans in the field. I was surveying the placement of pilings that would serve as the foundation for a public library. I went over the final construction plans and found 101 drafting errors. I laid out the piling placements with all the cross braces and then adjusted them using a least squares program I had written myself.

Interestingly, the City Engineering did not understand the least squares method of adjustment so he had my work checked by a private surveyor who performed an open ended traverse though the 19 piling placements. He said that my measurements were something like an inch off. They cut the steel to fit his placements and then that had to fabricate all new steel to fit my original measurements. Being able to make electronic field notes on the construction plans that go directly on the engineer's computer should reduce mistakes and speed up the process of construction considerably.

For more information go to www.adapx.com. There you'll find a desktop demo of the pen in ArcGIS that demonstrates how easy it is to use the pen in planning. 



ROBERT YOUNG'S EXPERIENCES BY MARC CHEVES, LS

At the ACSM show in Spokane, a portion of the ESRI booth was occupied by Adapx. One of our new writers, Robert Young from Texas, was quite impressed with the pen, so much so that his companies purchased 16 units. He runs two very successful companies: Young and Associates, and Digital Mapping Services, with offices in Fort Worth and Corpus Christi. Young and Associates does normal land development surveying as well as oil and gas surveying. Digital Mapping Services does GIS mapping for both the oil and gas sector and the land development sector.

To learn more about how the pens were implemented into these two company's workflows, I did a rare phone interview. Young laughed when he recalled the field crew's reactions: "Hey, we've always used a pencil, and now you want us to use an ink pen?" From my own early days in the field, I was taught that if a change was to be made, then a line was to be drawn through the old values and the new values added nearby—erasing was not allowed. And so I wondered, are the field guys erasing?

Large field books can be purchased with the digital (Anoto) pattern already printed on each page. The cost for these Rite-in-the-Rain field books is only two dollars more than what Young was already paying for normal large-size field books. He says they are not scanning the field notes, but rather taking them directly into Microsoft OneNote. Because the Anoto pattern is essentially a watermark, and each page is different, OneNote can keep track of which book, which page and what time the notes were taken.

Young foresees a myriad of applications, including GIS updates of existing maps. He even thinks that if the base map information is accurate enough, GPS locations would not even be needed for preliminary mark-ups. He mentioned a guy he knows who's responsible for urban sign maintenance. For field work, this guy is more comfortable with a map and a pen than he is with an expensive laptop. Another application is for pipeline routing. A field person with a map can sketch a proposed route based on what he or she visually sees on the ground. Many times an aerial won't provide enough detail and an existing map might be deficient because it's out of date. Young says they are using the USB download, but already sees a time when they can use the Bluetooth capability to transmit "I need it yesterday" information using their cell phones. The oil and gas industry is famous for needing information yesterday.

On the GIS side, the pen will be a natural for updating the sheets in order to maintain mapbooks. A future use will come from Autodesk and will allow them to redline construction drawings. Young said the map legend is critical because it contains not only all the symbols, but the layers as well. A user can simply pick a symbol (say, a fire hydrant) and wherever he or she touches the map, a hydrant will be added to the geodatabase on the correct layer.

Of the 16 pens, 12 are in use in the field and two in each of the offices. Young attends a lot of meetings and he's been using his pen to keep notes. The digital notes can be kept in raw form or they can be OCR'ed, making them available for any digital use.



A Young and Associates party chief uses the pen to sketch and annotate field locations.