# The Emergence of Computerized Sprinklers: Saving Water with Advanced Technology

Gary Klinefelter

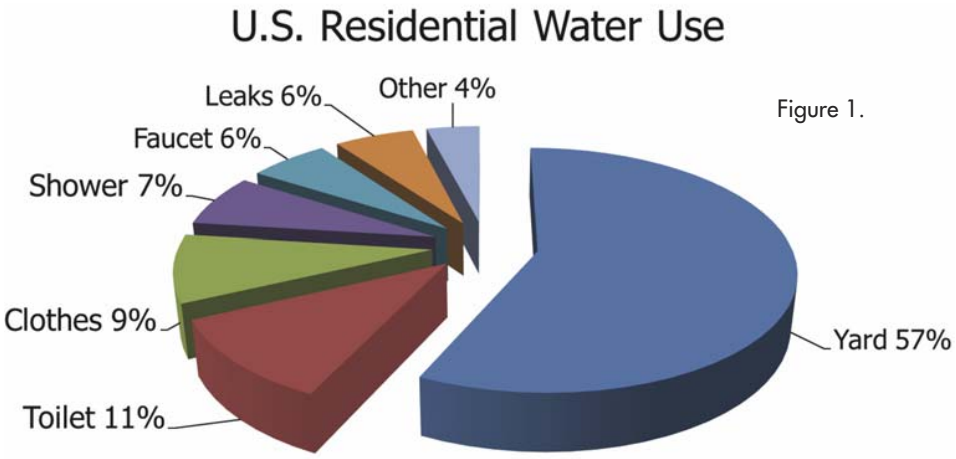



Figure 1.

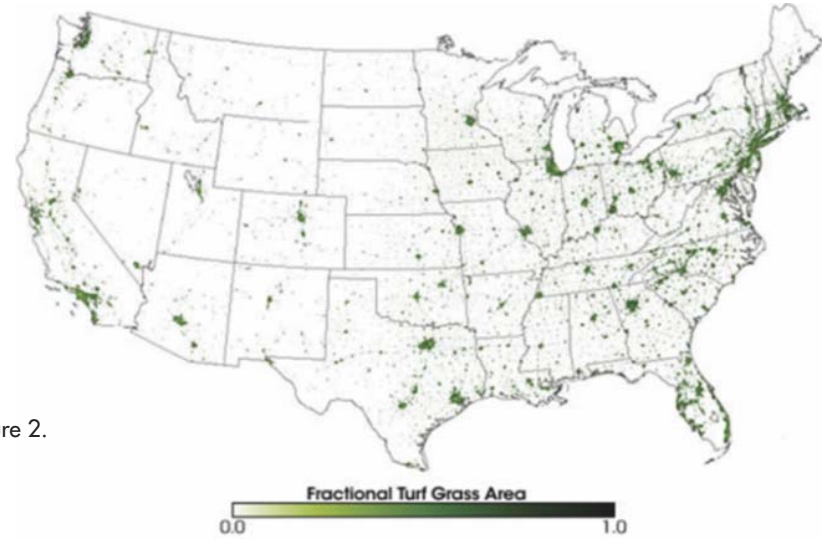



Figure 2.

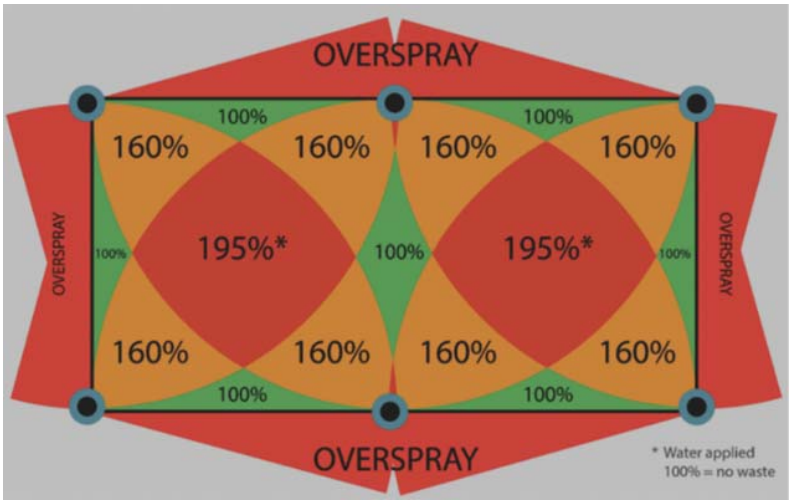



Figure 3.

## Water Use in the United States

**Where is the Water Going?**

Irrigation is the largest use of residential water in the United States—more than all others combined (Figure 1). Reducing irrigation water use is imperative to making communities more sustainable.

**Acres of Turf**

Americans love their lawns, and with good reason: they help clean the air, filter water, and provide children a place to play. In fact, the U.S. has more than 40 mil acres of grass (Figure 2). The proper amount of grass for any area may be dictated by the location and the climate, but regardless of the size, turf grass requires water—a lot of it.

**4-5 Billion Gallons Wasted Daily**

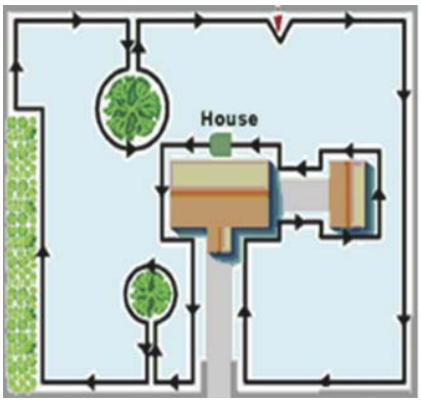
According to the U.S. Environmental Protection Agency, as much as 50 percent of the water used outdoors for lawn irrigation is wasted due to inefficient watering methods and systems. Everyone has seen irrigation systems spraying water when (during a rainstorm) and where (on the sidewalk) it's not needed. In addition to the inaccuracy, the design of most watering systems waste water in order to cover the lawn area uniformly.

## Current Technology

Current turf grass irrigation technology uses mechanical sprinkler heads, which water in an arc and are placed one head distance from each other so they overlap (Figure 3). This is the only way to achieve uniform watering. A distribution uniformity of .65 is shown for a watering zone with six mechanical sprinkler heads. System uniformity of field-tested systems ranges from .39 to .76 in various studies, averaging about .55.

Because conventional sprinklers need to overlap sprays, in this example, some sections of lawn get over-watered by 60 to 95 percent just so all sections receive enough water. This inefficiency is a limitation of current mechanical sprinkler technology.


Figure 4a. Aquarius: The Greenhouse Water Robot. *(Dorhout R&D LLC © 2013)*



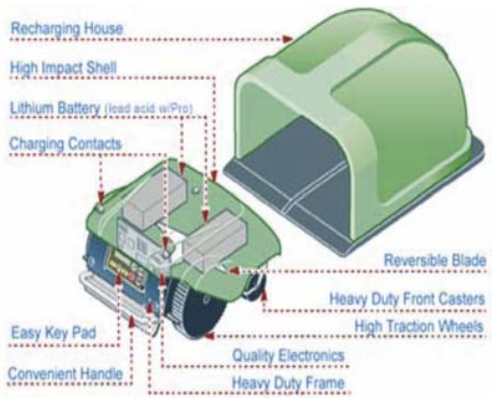




Figure 4b.

**What Happens When It Rains?**

Compare current irrigation technology with what happens when it rains, which provides uniform precipitation throughout the lawn. Irrigation water budgets are usually based on rainfall, which makes meeting a water budget with current mechanical technology very difficult. How can computer technology be used to water the lawn more evenly, like rain?

**What's Enabling New Innovations?**

What advances in technology will improve irrigation efficiency? In other areas of the economy, digital cameras and printers have led to small powerful motors, cell phones have improved human interfaces and offered advanced computing power in small packages, and global positioning systems (GPS) and satelite imagery are being used in agriculture to improve farming efficency and water use. There are now robotic vacuums; how about robotic sprinklers? How can these recent advances in technology be applied to irrigation sprinklers and systems?

**Controller Innovations**

New technology has enabled progress in irrigation controller innovation. Internet-connected irrigation controllers intelligently turn off a sprinkler to save water, replacing irrigation clocks that are only time-based. These new controllers make seasonal adjustments using weather data and moisture sensors, and many of them communicate with a cellphone, turning off sprinklers when they're not needed.

**Sensor Innovations**

Moisture sensor innovation has advanced from wired to wireless sensors. It has also moved from simple rain detectors to more advanced moisture sensors and weather stations. These new sensor technologies enable more fine-tuning of each watering cycle, which optimizes grass health and watering efficiency.

Like controller innovations, sensor innovations improve irrigation efficiency by determining when a sprinkler system should run; however, once the system turns on, current mechanical sprinklers still waste water with overlapping sprays. In the industry, this is called "smart control, dumb sprinkler."

**Mechanical Versus Robotic**

In many industries, the transition from mechanical to robotic technology has brought about efficiencies and created new opportunities. Mechanical sprinklers have evolved in both underground and above ground designs, but they do not provide the same type of precision that might be expected from, say, an inkjet printer. Computer control opens new opportunities to direct water to the shape of the landscape and limit water to the microclimate.

Another advantage of computer versus mechanical technology can be in labor savings, as in the case of a robotic sprinkler that waters plants in a greenhouse. The only difference compared to traditional irrigation is getting the tank filled up for each watering run.

How about this idea for a robotic lawn mower? All that's needed is a tank for water and the mower becomes a watering machine (Figures 4a and 4 b).

**Computer-Controlled Stream Volume**

Around 2009, AccuRain™ started selling a computerized sprinkler globe that was designed for watering plants and turf grass (Figure 5). Each sprinkler head could:

- Water over 1900 sq ft
- Have up to 15 watering zones of almost any size or shape
- Monitor itself and report errors

Here's an example of using small motors and powerful computing from printer and cell phones innovations to direct a stream of water to plantings. According to the company website, there is a hand-held device that is used to program points defining the landscape. An area that's 1900 sq ft approximates a 30-in. by 60-in. rectangle, which would have six mechanical heads spaced 30 ft apart around the edge. Computer technology reduces the number of heads and simplifies the design.

Potential limitations of this system would be the time it would take to water a large area of turf with a single stream and the physical size for a permanent installation.

*Continued on page 46*

Figure 5.

*Continued from page 45*

**Computer-Controlled Spray Volume**

Another innovator in computerized sprinklers is Innogation. Its product uses a single-spray nozzle with the ability to electronically control the spray volume as it rotates. The difference in the water distribution is shown in Figure 6. According to the company, an intelligent system can reduce water use by 40 to 50 percent in most cases. The ittigation head would be placed in the middle of the lawn and rotate around in smaller and smaller squares. Similar to the AccuRain sprinkler, it may take longer to water large turf areas.

**Computer-Controlled Stream X-Y Position**

A similar variation in computerized sprinkler heads is from another company called Droplet. Its product (Figure 7) uses a single stream that is computer-controlled in rotation and trajectory. The fixed-flow stream is programmable using a phone or computer. This design is largely aimed at watering plants, similar to AccuRain. The product is hose-connected and programmed for a particular area where the sprinkler is set on the landscape. This design would have similar limitations to the previous sprinklers in watering time and physical size for permanent landscape irrigation.

**Multivolume Streams**

The newest underground irrigation system utilizing a computerized sprinkler is the Irri-Green Genius® System (Figure 8). The company took a new approach, covering a large area like current mechanical spray heads using multivolume streams, but the stream gets bigger the farther it is from the head. The patented nozzle design provides sufficient streams to cover the lawn uniformly from 5 to 35 ft. Each stream has a different trajectory, and unlike sprays, it can adjust the distance as it rotates to conform the watering patterns to the shape of the lawn. The stream distance and application rate is continuously adjusted using a computer. The system is designed to apply 0.05 in. of water with each revolution, thus allowing the system to water in inches rather than in minutes by adjusting revolutions. The computer removes all the design work needed with mechanical technology to match precipitation both within a zone, and from zone to zone. A mobile phone app is used to train the sprinkler and set the watering schedule.

**Computer-Controlled Shape**

Another challenge for current mechanical sprinkler technology is watering an oddly shaped area. Overlapping head-to-head mechanical sprinklers are designed to water squares and rectangles; they do not have the adaptability to negotiate curves and corners or to water around obstructions. So, not only do they lose efficiency from overlap, but also from the failure to conform to the shape of the landscape. Mechanical heads are usually placed at the edge of the landscape and overspray onto hardscapes. A computer-controlled sprinkler placed in the

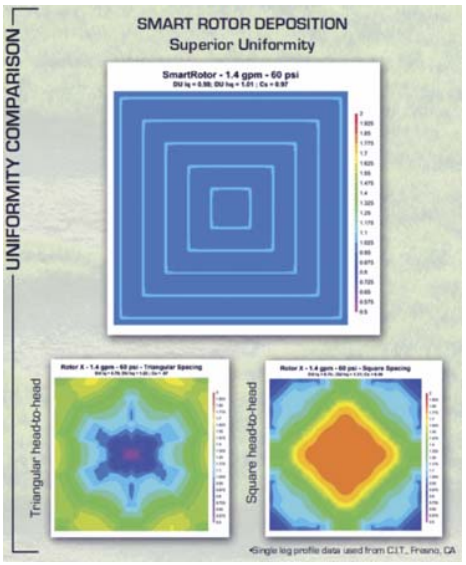



Figure 6.

Figure 7.

Figure 8.

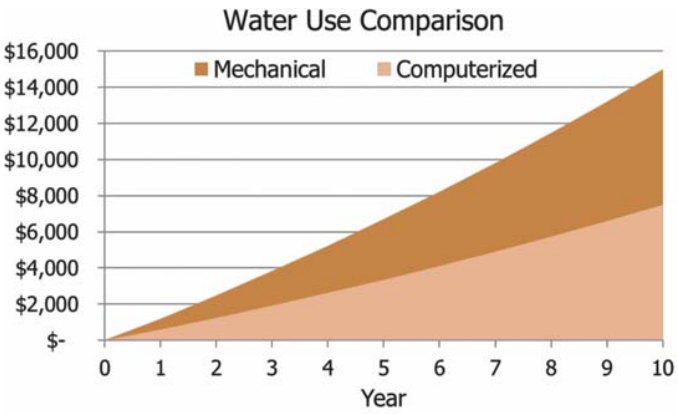



Figure 9.

center of the lawn without the need to be placed head-to-head can be adjusted to avoid hardscapes and runoff that results in water loss and pollution.

## Water and Other Savings

Computerized sprinklers can provide huge water savings, with an opportunity to reduce water use up to 50 percent compared to mechanical heads. There is also significant labor savings during installation due to fewer heads used, and these savings are a valuable installation benefit that provides a competitive pricing model by offsetting the cost of more expensive computerized heads.

Water utilities will be especially interested in these irrigation water savings because it allows them to continue to grow their population with fewer capital expenditures in water production. In Figure 9, a 50 percent savings is depicted for a 10,000-sq-ft lawn with rising water rates.

**Mechanical Versus Computerized**

There are several differences in mechanical and computerized heads. The most significant difference may be to more accurately meet the water needs of the landscape by using computer technology to direct the water only where and when it's needed.

Mechanical

- Head-to-head coverage
- Proven design
- Inexpensive head
- Trained irrigation industry
- Difficult to match precipitation
- Mechanical adjustment

Computerized

- Fewer heads (less plastic pipe)
- Waters to the landscape shape
- No overlap, no overspray
- Less time to install
- Easy to reconfigure
- Talks to a phone

## Conclusion

Computerized sprinkler heads are making headway as an alternative to current mechanical heads used for irrigation. It will take time for computerized sprinklers to become recognized as a mainstream technology, but the potential advantages in watering efficiency, and faster and more economical installation, are strongly needed by consumers, installation contractors, and water utilities. There is no doubt that the advantage in computerized heads, like many other computer-based products, will drive its adoption.

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