The CEDRA Corporation's

COMMAND OF THE MONTH

A monthly information bulletin   **November 2012**

FEATURED COMMAND
Creating Special
Plane Curves

Application Description

Here's an interesting story. Most people who are familiar with The CEDRA Corporation know that we are very responsive to client requests. We try very hard to implement commands that our users what to see. We also apply the same effort to requests made by prospects or potential clients.

A while ago a prospect who utilizes ArcGIS in the agricultural sector called asking if we handled spirals. Proudly we said, yes we do! We were surprised that someone in the agricultural field would be interested in our spiral functionality but nonetheless a sale is a sale.

So the prospect says, let me see what your spirals look like. This took us aback a little because basically all spirals kinda look alike. Some may have more curvature than others but essentially there's nothing fancy about them. A more interesting question would have been how do you define the spirals rather than how it looks.

Well as it turns out, the prospect was not interested in roadway or highway spirals but rather geometric spirals that you learn about in a middle or high school geometry class. ArcMap does not offer this functionality, so he was looking for an extension that had this capability.

The application that the prospect was involved with was crop dusting where it was desired to have an airplane fly in ever expanding circles, such as those found in an Archimedes's spiral.

The CEDRA Solution

To address the application described above, the |Create Special Plane Curves| tool within the {CEDRA-AVland-PlaneCurveTools} toolbar, shown in Figure 1, was developed. As it turns out the math is not that complicated and we have code templates where it is fairly easy and quick to implement new tools.

Create Special Plane Curves Overview

With the ⌾ *Create Special Plane Curves* tool command the user is able to generate:

a.   an Archimedes' spiral,
b.   a Fermet's spiral,
c.   a Reciprocal spiral, else referred to as hyperbolic spiral, or
d.   a Lituus spiral.

> **Command Of The Month bulletin**
>
> *This month's issue discusses how to create Archimedes, Fermet, Reciprocal or Lituus spirals which are quite different from roadway spirals.*

Samples of these different types of spirals are displayed in Figure 2. The two direction lines contained in the four spirals of this figure will be addressed in the operational steps below.

It is noted that the four spirals displayed in this figure have been generated using the same spiral parameters as defined in the operational steps below. By specifying different parameters, particu-

**Figure 1
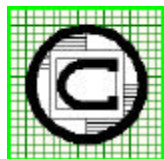CEDRA-AVland-PlaneCurveTools
Toolbar**

larly those pertaining to the increment angle and the starting direction for the Reciprocal and Lituus spirals, their shape can drastically change.

These spirals are not of the type that is applicable to roadway design, but they may be suited for certain other land related applications. For example, an Archimedes spiral may be used in airplane crop dusting or spraying applications in which an airplane takes off at a point and then flies around an open field in ever expanding circles, but at uniform increments, resembling an Archimedes spiral up to a limit referred to herein as the spiral radius.

Create Special Plane Curves Operation

To use this tool command, the user should after activating the tool:

➤ 1   **Click** at the point to denote the **spiral's center**, or origin, and display the input dialog box of Figure 3.

➤ 2   **Enter** in the *Increment Angle (Degrees):* data field an angle in degree decimal form to define the coarseness of the spiral.

(1) Archimedes' Spiral   (2) Fermat's Spiral

(3) Reciprocal Spiral   (4) Lituus Spiral
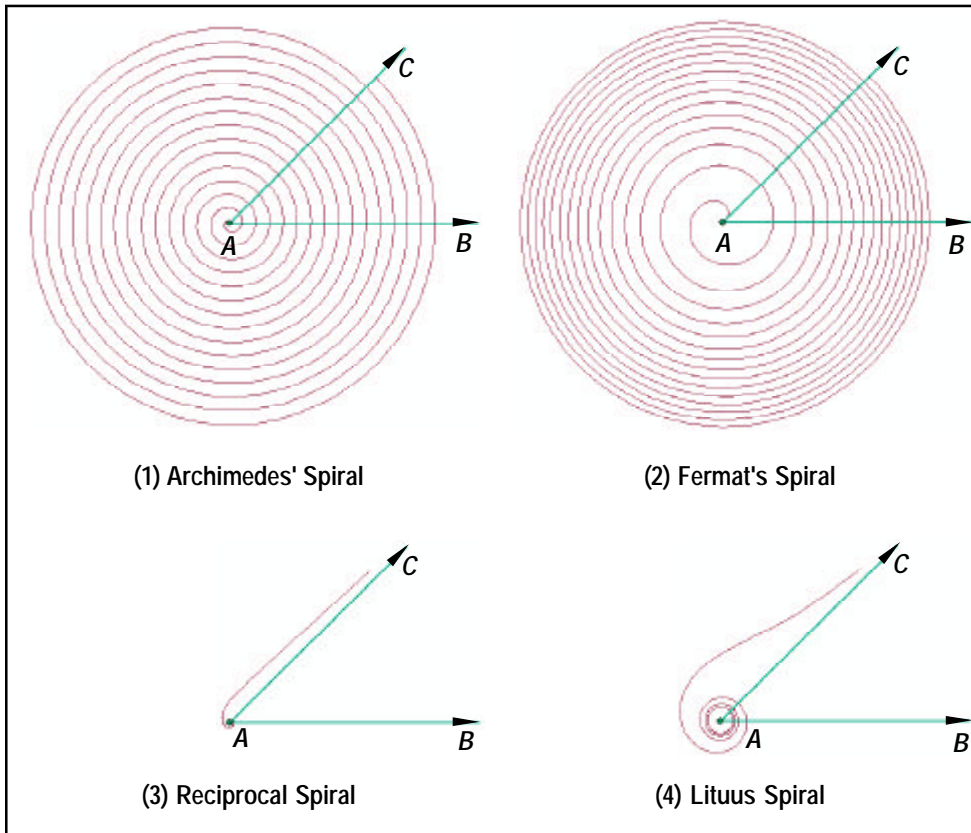
Figure 2   The Spirals of the Special Plane Curves Tool

Figure 3 - Special Plane Curves Multi-Input Dialog Box

Figure 4
Available Spiral Types

for every ring comprising the spiral 20 points will be computed. If the user enters 36, then 10 points will be generated per ring.

➤ **3   Enter** in the *Bandwidth Distance - ft (m):* data field in world units the width of the bandwidth between the spiral loops for the Archimedes spiral. In essence, this distance controls the number of rings for the Archimedes, Fermat and Lituus spirals. The number of rings is computed by dividing the spiral radius and by the bandwidth distance. For the Reciprocal or hyperbolic spirals the entry in this data field is of no consequence.

➤ **4   Enter** in the *Spiral Radius - ft (m):* data field in world units the radius of the spiral. This is the distance from the center of the spiral to the end of the spiral, the length of the line **AC** in Figure 2.

➤ **5   Enter** in the *Starting Angle (Cartesian Decimal Degrees):* data field the Cartesian direction of the line **AC**. In Figure 2, this is the angle **BAC** for the Archimedes and Fermat spirals. For the Reciprocal and Lituus spirals, the angle of inclination is defined as the direction from the center of the spiral to the start point of the innermost ring. For these last said two spirals, the direction from the center of the spiral to the end point of the outermost ring will be equal to the starting angle plus the increment angle. For example, if the increment angle is 30 degrees and the starting angle is 10 degrees, the direction from the center of the spiral to the end point of the outermost ring will be 40 degrees.
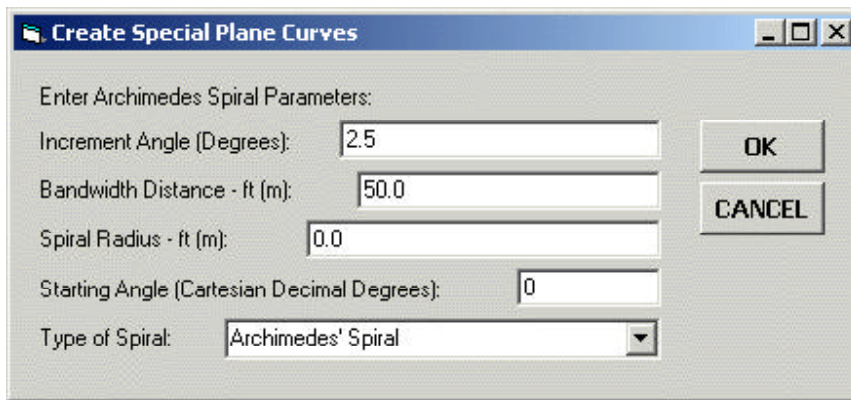
The value for the Increment Angle parameter enables the user to control the number of points that are computed for a single ring or loop of the spiral, and therefore the smoothness of its display. The number of points is computed by dividing 360° by the value entered in this data field. For example, if the user enters 18 then
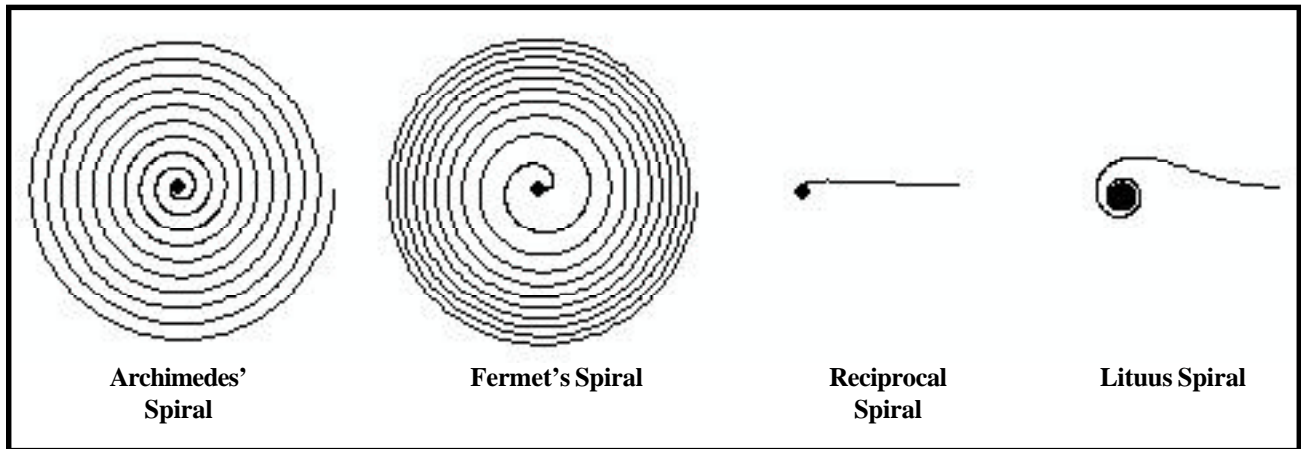
Archimedes' Spiral   Fermet's Spiral   Reciprocal Spiral   Lituus Spiral

Figure 5 - Special Plane Curves with a Bandwidth of 10, Spiral Radius of 100 and Starting Angle of 0 Degrees

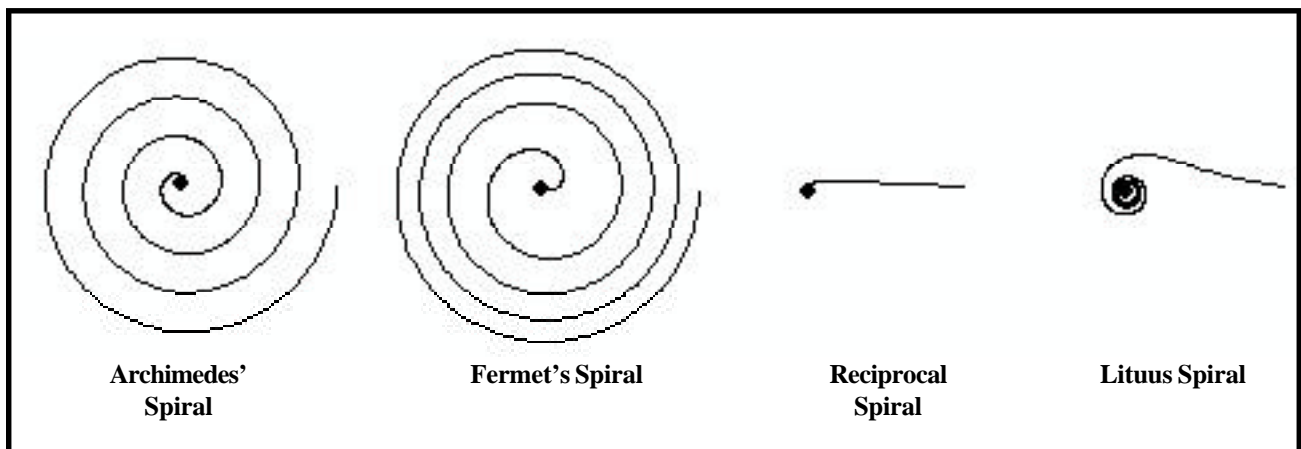Archimedes' Spiral   Fermet's Spiral   Reciprocal Spiral   Lituus Spiral

Figure 6 - Special Plane Curves with a Bandwidth of 25, Spiral Radius of 100 and Starting Angle of 0 Degrees

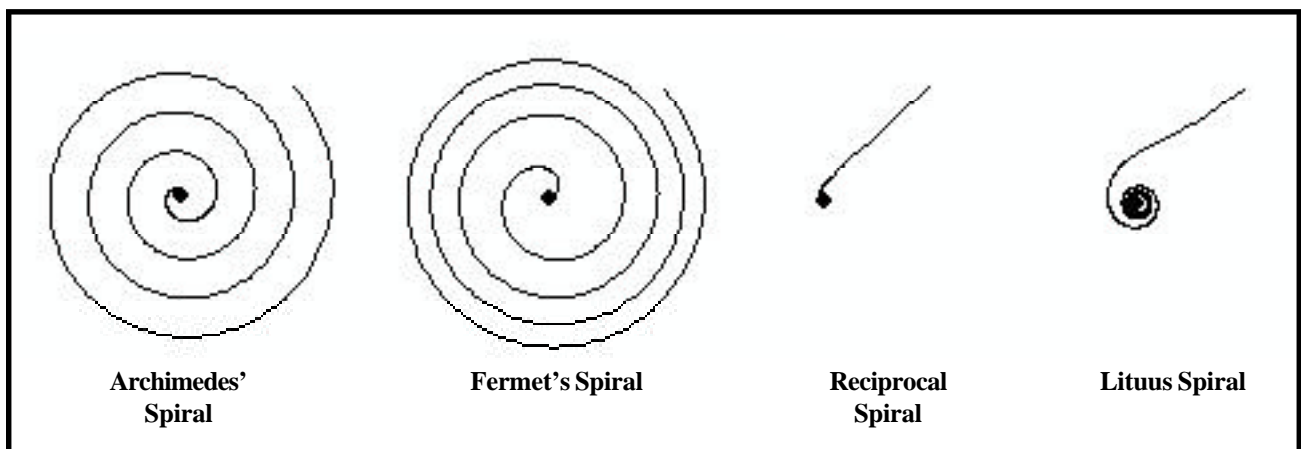Archimedes' Spiral   Fermet's Spiral   Reciprocal Spiral   Lituus Spiral

Figure 7 - Special Plane Curves with a Bandwidth of 25, Spiral Radius of 100 and Starting Angle of 45 Degrees

➤ **6** **Scroll** down in the *Type of Spiral:* data field , and **select** the option of the desired **spiral type**. Shown in Figure 4 are the available types of spirals.

➤ **7** **Click** at the **OK** button to generate the polyline representing the selected spiral,
or
click at the **Cancel** button to abort the command.

Having clicked at the *OK* button, and generated the spiral, which is stored in the current active layer, the subject command remains active to be repeated from Step 1.
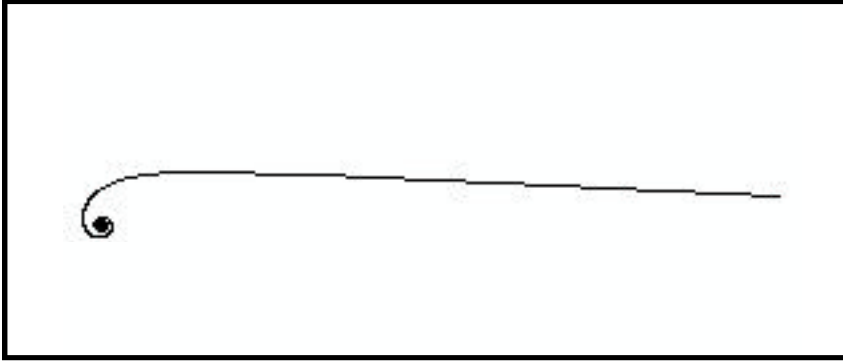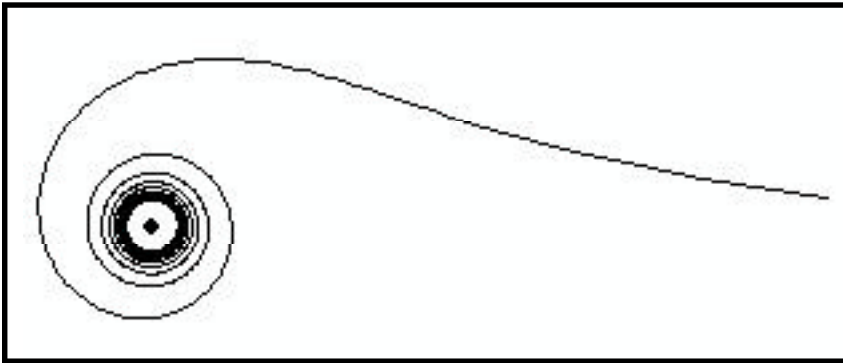
Figure 8 - Close-up of the Reciprocal Spiral

Figure 9 - Close-up of the Lituus Spiral

```
nRings = spiralRad / BandWidth
numPoints = (Fix(360# / incAng)) * nRings
```

Figure 10 - Equations used to determine Number of Points to be used
in representing the Spiral

Notes

a. Shown in Figures 5, 6 and 7 are the various types of spirals generated with specific bandwidth, spiral radius and starting angle values. The increment angle that was used to generate the spirals was the same. As can be seen, a larger bandwidth value reduces the number of rings with a given spiral radius value.

b. Shown in Figures 8 and 9 are close-ups of the spirals shown in Figure 5.

c. The feature that is created by this tool is a polyline feature and is stored in the current active layer.

d. The number of points comprising the polyline feature is computed using the equations shown in Figure 10.

Summary

Given that the main focus of CEDRA software is surveying, parcel mapping and civil engineering applications, the |Create Special Plane Curves| tool is outside the normal range of functionality that would be found in our software. However, this tool does demonstrate the willingness of us to incorporate functionality that is desired by our clients.

As always, users who have a need for functionality that is not presently available in CEDRA software should feel free to forward these requests to CEDRA, as well as, any other comments or suggestion you may have.

If you have a request for Command Of The Month, feel free to phone, fax or e-mail your request to The CEDRA Corporation.