Cookbook of Examples

DISTORTING GDI+ PATHS WITH OTHER PATH OBJECTS

SCINTILLA4EVR, 2016

Mathematical basis

Linear interpolation

Before we begin, let's define the linear interpolation function, which will map $\langle 0, 1 \rangle$ to $\langle a, b \rangle$:

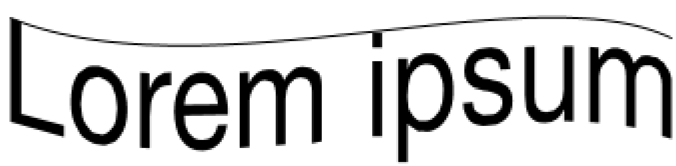
$$lerp(x, a, b) = x(b - a) + a,$$

where:

- x – a value in range $\langle 0, 1 \rangle$,
- a – bottom limit of the output range,
- b – top limit of the output range.

Single curve distortion

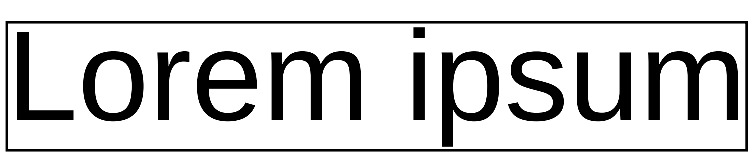
Let's start with a simple single-curve distortion:



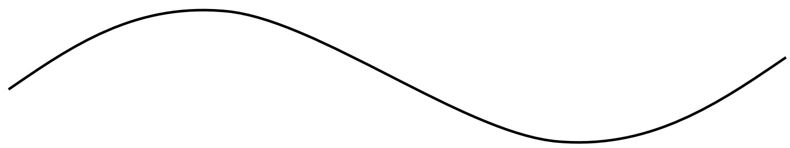
Text "Lorem ipsum" distorted with a single Bezier curve.

Our input path will be "Lorem ipsum":

Now, let's define the **bounding box** of the path:



Now, let's define the curve, which will displace every point of the input path:



Every X coordinate of the text and the curve has to be mapped to $\langle 0, 1 \rangle$ range. We can do this by dividing the coordinate by the width of the path's bounding box:

$$x' = \frac{x}{w},$$

where:

- x' – mapped coordinate,
- x – coordinate before mapping,
- w – width of the bounding box.

Now every point on the input path should be able to be represented as:

$$P = (x', y).$$

Now we have to find a point on a curve. Before we can do that, we have to calculate its X coordinate:

$$X = B_x + x'B_w,$$

where:

- B_x – X coordinate of the top-left point of curve's bounding box,
- B_w – width of the curve's bounding box.

Also, we have to find a point C on the curve, where:

$$C = (X, Y),$$

where:

- X, Y – **world coordinates** of the point

Now, for every point on the text and an associated point on the curve, we can transform the input path:

$$P' = (X, y + Y),$$

where:

- P′ – transformed point.

Double curve distortion

Text "Lorem ipsum" distorted with two Bezier curves.

Distorting the path with two curves is analogous, but we have to define two points: C_1 and C_2, one for each curve:

$$C_1 = (X_1, Y_1),$$
$$C_2 = (X_2, Y_2).$$

Also, we have to define Y coordinate of the input point in the same way we did with the X coordinate:

$$y' = \frac{y}{h},$$

where:

- y′ – mapped coordinate,
- y – original Y coordinate,
- h – height of the bounding box.

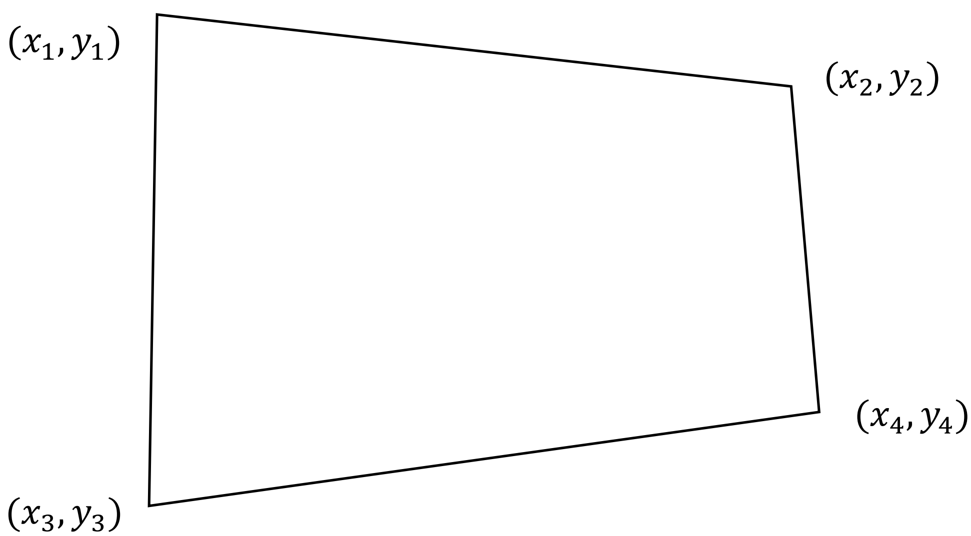
Then, we have to use linear interpolation defined earlier, to displace the point:

$$P' = \left(lerp(y', X_1, X_2), lerp(y', Y_1, Y_2)\right)$$

Case study: Quadrilateral distortion

Quadrilateral distortion is used in image editing for creating perspective, fitting images to a 3D plane, etc.

Formula



To apply quadrilateral distortion, we'll need to modify the double-curve distortion formula, specifically the C_1 and C_2.

$$C_1 = \left(lerp(x', x_1, x_2), lerp(x', y_1, y_2)\right),$$
$$C_2 = \left(lerp(x', x_3, x_4), lerp(x', y_3, y_4)\right).$$

So, the distorted point now is:

$$P' = \Big(lerp\big(y', x(C_1), x(C_2)\big), lerp\big(y', y(C_1), y(C_2)\big)\Big),$$

where $x(A)$ and $y(A)$ are the coordinates of A.