

Figure 2.1: The compound mapping is the composition of the surface parameterization and the viewing projection.

```
SCREEN ORDER:
  for y
    for x
      compute u(x,y) and v(x,y)
      SCR[x,y] = TEX[u,v]
```

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```
TEXTURE ORDER:
  for v
    for u
      compute x(u,v) and y(u,v)
      SCR[x,y] = TEX[u,v]
```

```
MULTI-PASS:
  for v
    for u
      compute x(u,v)
      TEMP[x,v] = TEX[u,v]
  for x
    for v
      compute y(x,v)
      SCR[x,y] = TEMP[x,v]
```

where TEX is the texture array, SCR is the screen array, and TEMP is an intermediate array.

\Downarrow MAP1 \circ MAP2 \Rightarrow	affine	bilinear	projective
affine	affine	bilinear	projective
bilinear	bilinear	biquadratic	rational bilinear
projective	projective	rational biquadratic	projective

Thus, the composition of two bilinear mappings is a biquadratic mapping.

PROPERTY	AFFINE	BILINEAR	PROJECTIVE
preserves parallel lines	yes	no	no
preserves lines	yes	no [†]	yes
preserves equispaced points	yes	no [†]	no
maps square to	parallelogram	quadrilateral	quadrilateral
degrees of freedom	6	8	8
closed under composition	yes	no, biquadratic	yes
closed under inversion	yes	no, solve quadratic	yes
single-valued inverse	yes	no	yes
forms a group	yes	no	yes
incremental forward mapping	2 adds	2 adds	2 divs, 3 adds [‡]
incremental inverse mapping	2 adds	1 square root, more	2 divs, 3 adds

[†]except for horizontal and vertical lines in source space

[‡]see §2.3.5

For the designer, affine mappings are the simplest of the three classes. If more generality is needed, then projective mappings are preferable to bilinear mappings because of the predictability of line-preserving mappings. For the implementer, the group properties of affine and projective mappings make their inverse mappings as easy to compute as their forward mappings. Bilinear mappings are computationally preferable to projective mappings only when the forward mapping is used much more heavily than the inverse mapping.

Zobrazenie t sa často definuje tabuľkou s celočíselnými hodnotami. Môžu to byť obrázky zosnímané skenerom alebo vytvorené grafickým editorom, ktoré ukladajú informáciu v diskretnej podobe. Inverzné zobrazenie mapuje do oblasti D , vo všeobecnosti reálnymi hodnotami, preto musíme vedieť interpolovať chýbajúce hodnoty. Najčastejšie sa využíva **bilinéarna interpolácia**.

Chceme získať hodnotu $t(x, y)$, preto označme najbližšie hodnoty nasledovne:

$\lfloor x \rfloor$ - zaokrúhlenie smerom dole na celočíselnú hodnotu a

$\lceil x \rceil$ - zaokrúhlenie smerom hore,

$$t_{11} = t(\lfloor x \rfloor, \lfloor y \rfloor), \quad t_{12} = t(\lfloor x \rfloor, \lceil y \rceil),$$

$$t_{21} = t(\lceil x \rceil, \lfloor y \rfloor), \quad t_{22} = t(\lceil x \rceil, \lceil y \rceil).$$

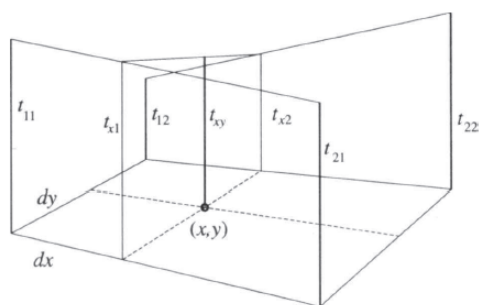
Z obrázku 15.2 vidíme ako vypočítať hodnotu $t(x, y)$ pomocou interpolácie:

$$t_{x1} = t_{11}(1 - dx) + t_{21}(dx), \quad t_{x2} = t_{12}(1 - dx) + t_{22}(dx),$$

$$t(x, y) = t_{x1}(1 - dy) + t_{x2}(dy).$$

Po úprave

$$t(x, y) = t_{11} + (t_{12} - t_{11})dy + [t_{21} - t_{11} + (t_{11} - t_{12} - t_{21} + t_{22})dy]dx$$



Obr. 15.2 Výpočet interpolovanej hodnoty $t(x, y)$

[Ru]

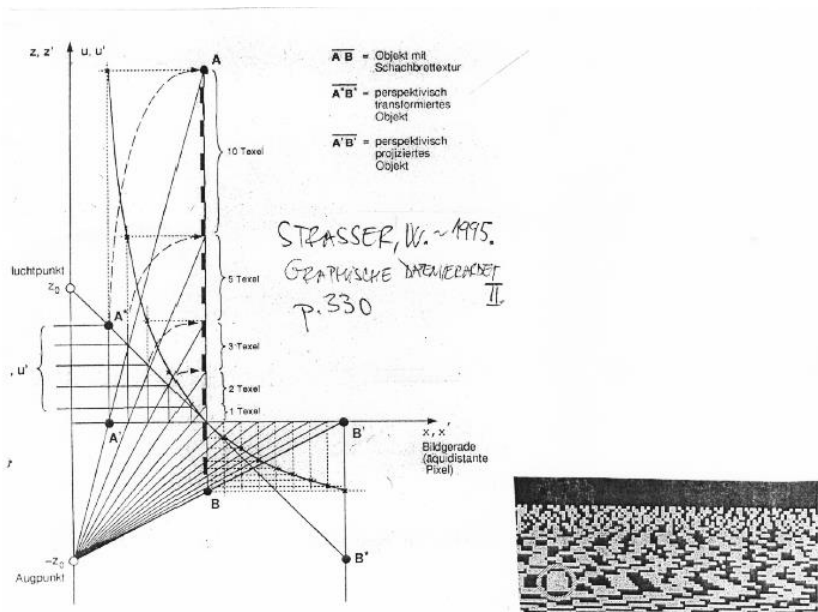


Abb. 7.4: Zusammenhänge bei der perspektivischen Projektion einer Textur

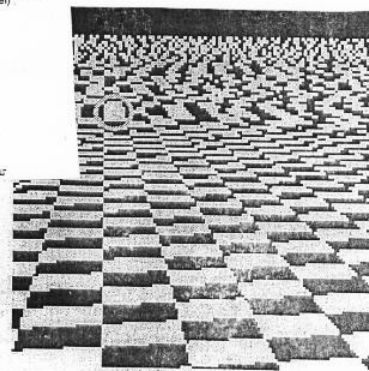


Abb. 7.10: Aliasing: Auftreten von Scheinstrukturen durch diskretes Abtasten

[Strasser]

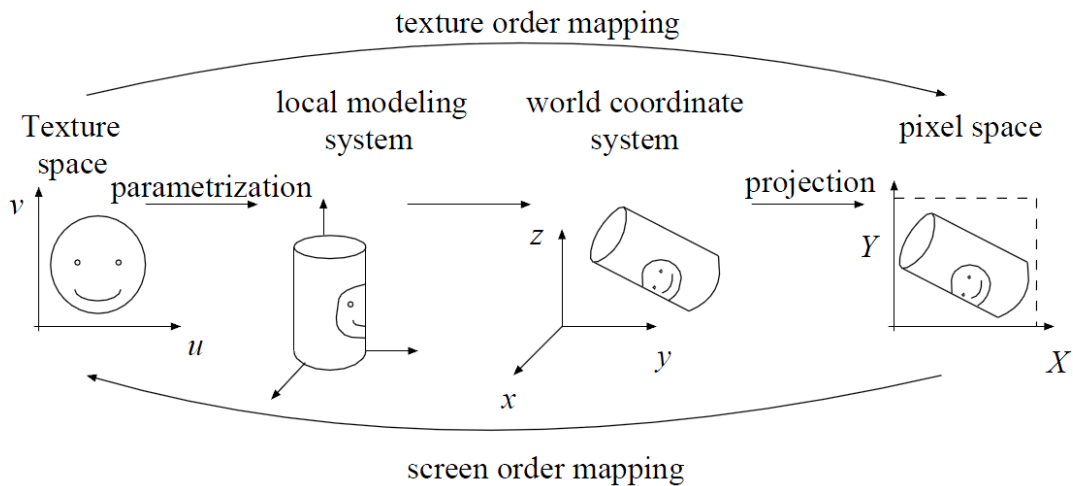


Figure 12.1: Survey of texture mapping

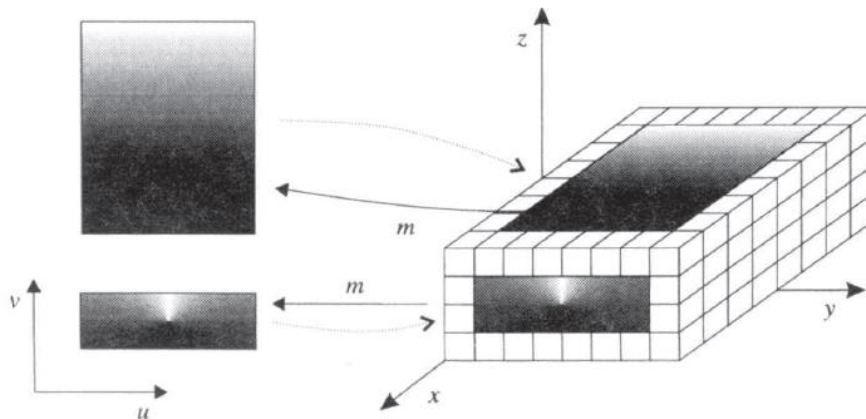
[Szirmay-Kalos]

Z matematického hľadiska definujeme **všeobecnú textúru** ako zobrazenie rovinatej oblasti do modulovaného priestoru, ktorým môže byť priestor farieb alebo úrovni šedej

$$t : D_t \rightarrow M, \text{ kde } D_t \subseteq \mathbb{R}^2 \text{ a } M \subseteq \mathbb{R} (R^3).$$

Ak máme zadaný tvar objektu, tak pomocou inverzného mapovania budeme zobrazovať pre každý bod povrchu bod z oblasti textúry

$$m : D_m \rightarrow D_t, \text{ kde } D_m \text{ je oblasť na povrchu objektu.}$$



Obr. 15.1 Mapovanie textúry (texture mapping)

Parameterization of a sphere

The implicit definition of a sphere around a point (x_c, y_c, z_c) with radius r is:

$$(x - x_c)^2 + (y - y_c)^2 + (z - z_c)^2 = r^2. \quad (12.2)$$

An appropriate parameterization can be derived using a spherical coordinate system with spherical coordinates ϕ and θ .

$$\begin{aligned} x(\phi, \theta) &= x_c + r \cdot \cos \theta \cdot \cos \phi, \\ y(\phi, \theta) &= y_c + r \cdot \cos \theta \cdot \sin \phi, \\ z(\phi, \theta) &= z_c + r \cdot \sin \theta. \end{aligned} \quad (12.3)$$

The spherical coordinate ϕ covers the range $[0..2\pi]$, and θ covers the range $[-\pi/2.. \pi/2]$, thus, the appropriate (u, v) texture coordinates are derived as follows:

$$u = \frac{\phi}{2\pi}, \quad v = \frac{(\theta + \pi/2)}{\pi}. \quad (12.4)$$

The complete transformation from texture space to modeling space is:

$$\begin{aligned} x(u, v) &= x_c + r \cdot \cos \pi(v - 0.5) \cdot \cos 2\pi u, \\ y(u, v) &= y_c + r \cdot \cos \pi(v - 0.5) \cdot \sin 2\pi u, \\ z(u, v) &= z_c + r \cdot \sin \pi(v - 0.5). \end{aligned} \quad (12.5)$$

For texture order mapping, the inverse transformation is:

$$\begin{aligned} u(x, y, z) &= \frac{1}{2\pi} \cdot \arctan^*(y - y_c, x - x_c), \\ v(x, y, z) &= \frac{1}{\pi} \cdot \left(\arcsin \frac{z - z_c}{r} + \pi/2 \right), \end{aligned} \quad (12.6)$$

where $\arctan^*(a, b)$ is the extended arctan function, that is, it produces an angle ξ in $[0..2\pi]$ if $\sin \xi = a$ and $\cos \xi = b$.

General surfaces

A general technique developed by Bier and Sloan [BSS86] uses an intermediate surface to establish a mapping between the surface and the texture space. When mapping from the texture space to the surface, first the texture point is mapped onto the intermediate surface by its parameterization, then some "natural" projection is used to map the point onto the target surface. The texturing transformation is thus defined by a two-phase mapping.

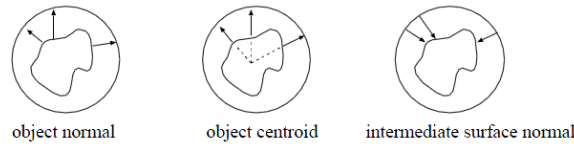


Figure 12.3: Natural projections

The intermediate surface must be easy to parameterize and therefore usually belongs to one of the following categories:

1. Planar polygon
2. Sphere
3. Cylinder
4. Faces of a cube.

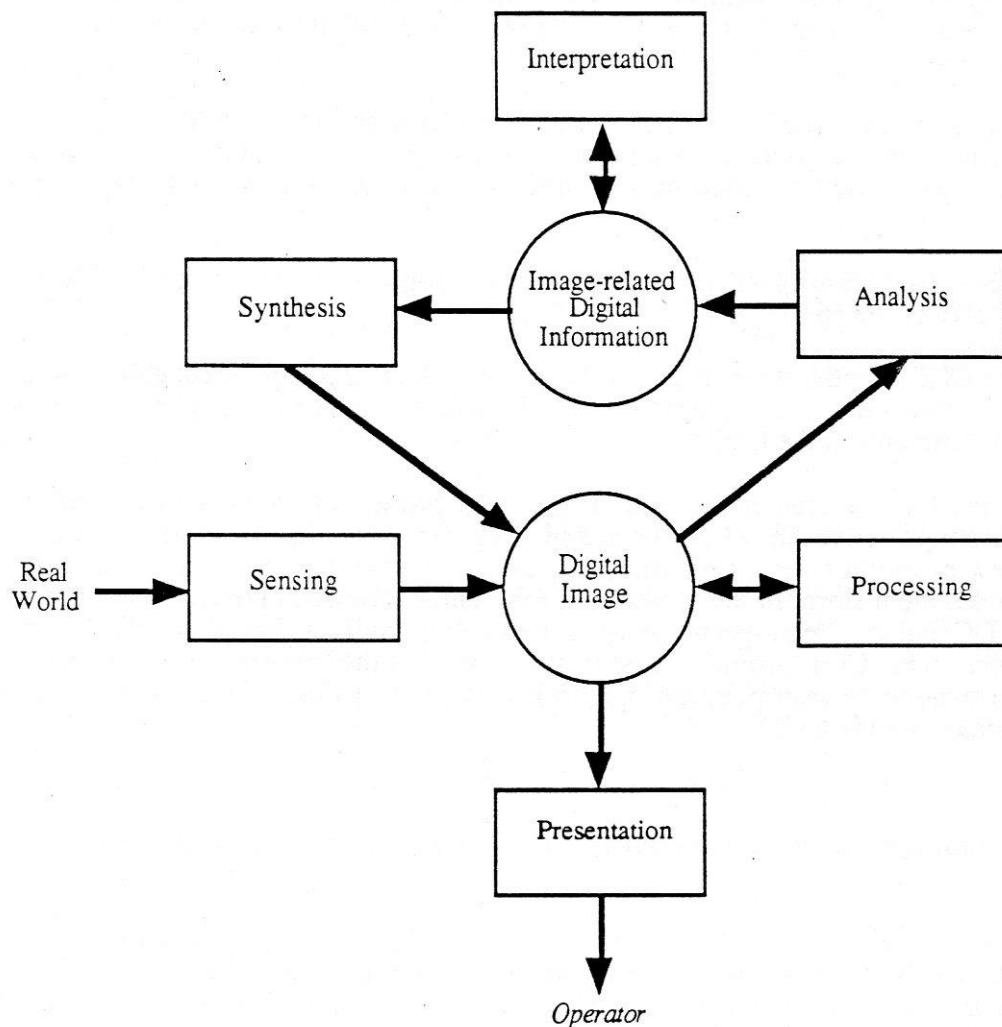


Figure B.1 – Computer imaging model

Pojmový model pre syntézu a analýzu obrazu podľa normy CGRM (Computer Graphics Reference Model).

Príbuzné pojmy v angličtine sú Visual Computing a Imaging. V matematickom modelovaní (v tradícii mimésis) minimalizujeme chybu geometrie, rádiometrie, kinematiky a uveriteľnosti (believability), sprítomnený obraz má byť realistický. Vo vedeckotechnickej vizualizácii (v tradícii poiésis, nonfotorealistic rendering, expressive rendering) maximalizujeme porozumenie, zanedbávame mnohé detaily, abstrahujeme, schematizujeme, štylizujeme...

Spracovanie informácie z reálneho sveta sa začína snímaním alebo nakreslením obrázka. Ak poznáme model, nazývame obrázok po anglicky picture, ak model nepoznáme, máme iba raster, textúru, sken, obraz po anglicky voláme image. Bez poznania modelu ho môžeme spracovať (Image Processing) alebo sprítomniť, prezentovať sebe alebo ďalším.

Analýzou a interpretáciou obrazu získavame dáta, metadáta a paradáta, napr. názov obrazu a jeho URL. Syntézou obrázka získame dáta na ďalšie spracovanie, prezentáciu, interpretáciu... Analýza sa označuje aj ako počítačové videnie (Computer Vision).