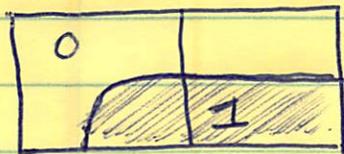


ESTIMATION OF MATERIAL FRACTIONS (continued...)

• Problem: Given only ONE density/intensity value per cell (=voxel), what are the material fractions of the material types lying partially in the cell?

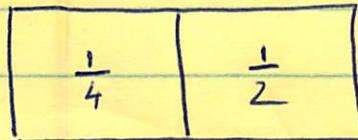
Assumption: All materials are homogeneous.

• Example:

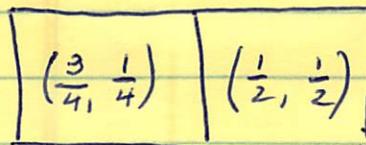


□ Type 1 - value 0
▨ Type 2 - value 1

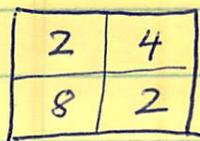
⇓ averaged values
produced by imaging



⇓ goal: reproduce material fraction tuples
per cell: (w_1, w_2) , w_i = fraction
of type i



• 3-material
example:



⇐ ONE cell containing 3 types
with "pure" values 2, 4 and 8

⇓ "imaged" average value $I = \frac{1}{2} \cdot 2 + \frac{1}{4} \cdot 4 + \frac{1}{4} \cdot 8$
= 4

■ MATERIAL FRACTIONS...

$\Rightarrow I = w_1 I_1 + w_2 I_2 + w_3 I_3$ /* 3-material case */

- \Rightarrow • Must know the no. of distinct materials.
- Must know the "pure" intensity value I_i for material i when imaged.

• 2-material case (most important):



↑ 1 cell

mat 1 $\rightarrow I_1$, mat 2 $\rightarrow I_2$
"mixture":

$I = w_1 I_1 + w_2 I_2$

/* unknowns: w_1, w_2 */

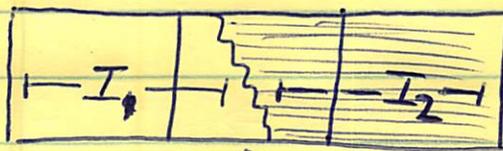
/* $w_1 + w_2 = 1$ */

(• w_1, w_2 are the needed fractions of materials 1, 2 occupying the cell.)

$I = w_1 I_1 + (1 - w_1) I_2$
 $= I_2 + w_1 (I_1 - I_2)$

$\Rightarrow w_1 = \frac{I - I_2}{I_1 - I_2}, w_2 = 1 - w_1$

• CONTEXT:

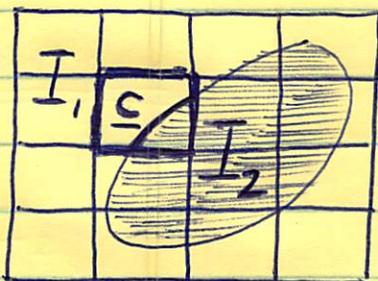


pure mat 1 mixture pure mat 2

3 cells,
2 materials

MATERIAL FRACTIONS ...

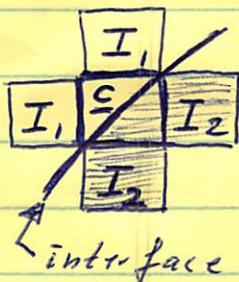
- GOAL: Obtain better VOLUME ESTIMATES, especially in cases when objects/materials are likely to cover a relatively large no. of cell only partially (\Rightarrow THIN OBJECTS!)



2-material case:

OBTAIN "PRECISE" TOTAL VOLUME OCCUPIED BY THE I_2 -TYPE MATERIAL!

- (1) SUM UP THE VOLUMES OF ALL "PURE" I_2 -TYPE CELLS ("FULL CELLS").
- (2) SUM UP THE FRACTIONAL VOLUMES OF ALL CELL THAT CONTAIN MATERIAL 2 PARTIALLY.
- (3) ISSUE: NEEDED IS A CONDITION THAT, WHEN SATISFIED, INDICATES THAT CELL C CONTAINS FRACTIONS OF MAT 1 AND MAT 2!



For example:

"The neighbor cells of C are ('nearly') purely type-1 (I_1) or type-2 (I_2) cells." \approx BH