
Solid Modeling Implementation

And what is a non-manifold solid?

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Euler Operators

The Euler-Poincare formula says how many faces, edges, vertices, etc. are on a valid solid:

$$v - e + f - h = 2(s - p)$$

where the variables give the number of:

v – vertices

h – hole loops

e – edges

s – shells

f – faces

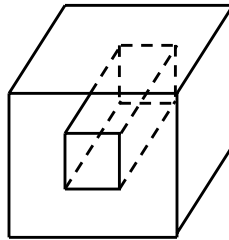
p – passages

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Euler Operators

For example, given the shape shown,



$16 - 24 + 10 - 2 = 2(1 - 1)$
therefore shape is valid manifold.

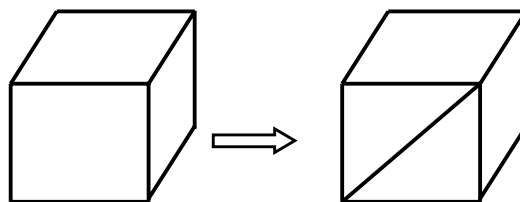
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Euler Operators

Euler operators provide specific topology changes that guarantee that the Euler-Poincare formula is maintained.

- The operator “Make an Edge and a Loop” (MEL) is shown.



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MEVLS (KEVLS)	make (kill) edge, two vertices, loop, shell	
MEL (KEL)	make (kill) edge, loop	
MEV (KEV)	make (kill) edge, vertex	
MVE (KVE)	make (kill) vertex, edge	
MEKH (KEMH)	make (kill) edge, kill (make) hole	
MZEV (KZEV)	make (kill) zero length edge, vertex	
MPKH (KPMH)	make(kill) peripheral loop, kill (make) hole loop	

Figure from K.Lee, "Principles of CAD/CAM/CAE Systems," Addison-Wesley

How Solid Boolean Operators Are Implemented

1. Split edges at intersections.
2. Determine whether each edge is inside, outside, or on the boundary of the other solid.
3. Recombine edges according to the type of the Boolean operation.

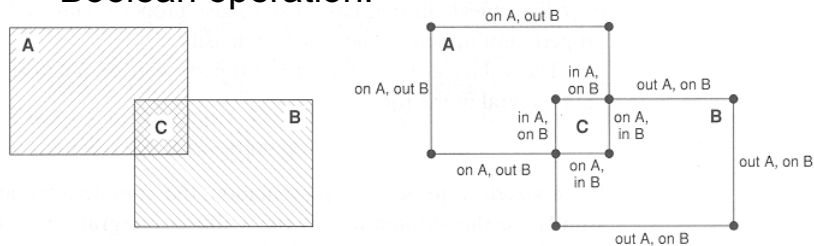


Figure from K. Lee, "Principles of CAD/CAM/CAE Systems," Addison-Wesley
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Nonmanifold Solids

- In a manifold solid, every point on a surface is **locally two-dimensional**.
(A bug traveling on the surface can always move forward, backward, left, and right.)
- Here are some non-manifold models:

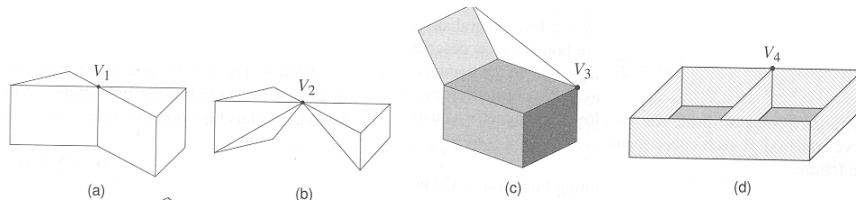


Figure from K. Lee, "Principles of CAD/CAM/CAE Systems," Addison-Wesley
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