## **Care & Feeding of Machines**

- Feeding parts
  - orientation
  - singulation
- Material obtained from:
  - Boothroyd, Automatic Assembly
  - Ken Goldberg, UCB Industrial Engr Oper. Rsrch
    - (http://www.ieor.berkeley.edu/~goldberg/index.html)
    - Robert-Paul Berretty, PhD thesis, Utrecht (http://www.library.uu.nl/digiarchief/dip/diss/1940512/full.pdf)

# **Designing Parts for Feeding**



## Symmetry



## Asymmetry



# **Tangling**



## **Shingling**



# Wedging



## **Designing for Insertion**



## Simplifying the Design



### **Fastener Feeding Requirements**

- Orientation
  - vibrating bowl
  - non-vibrating feeders
    - (see Boothroyd Assembly Automation)
- Singulation

   escapement mechanisms
   pick and place
- Vision and Robots
- Pre-collated components



Fig. 5.24 Escapements actuated by the work carrier.







Fig. 5.27 Ratchet escapements operated by linear motion.

6-12

## **Gravity Feeders**















## **Bowl Feeders · Trap Design**



Figure 4: The types of rejected poses.

Figure 5: A critical pose.

## **Bowl Feeders · Trap Design**



#### **Non-vibrating Feeders**



#### **Non-vibrating Feeders**



#### Pick & Place



#### Pick & Place



#### **Pre-collated Components**



## Conveyors



#### **Conveyor part orientation - pins**



Figure 3. Two phases of toppling: rolling and settling.

#### **Conveyor part orientation - pins**



## **Conveyor part orientation - pins**



# Conveyor part orientation - fences



Figure 3.2 (a) For two successive left fences, the reorientation of the push direction lies in the range (0, π/2). (b) The ranges op possible reorientations of the push direction for all pairs of fence types.

 Any polygonal part can be oriented up to symmetry by a fence design

# Conveyor part orientation - fences



# Conveyor part orientation - fences



# Conveyor part orienting - 3D parts

