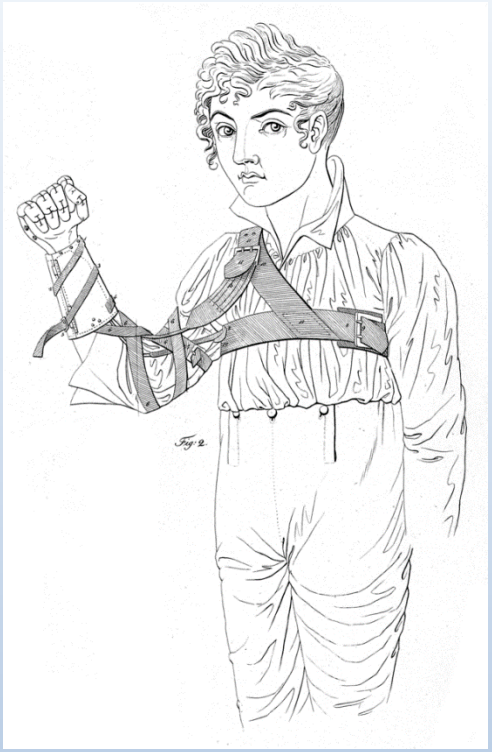
No More Peg Legs and Hooks

Better Prosthetic Design through Engineering

History of Prostheses

- Used in Greek and Roman times
- Prosthetic toe found on 3000-year-old Egyptian mummy
- Before 1840s, few survived amputation and prosthetic supplies were often scavenged
- Surgery advances (anesthesia in 1842) > more precise surgeries and better prosthetic fit
- So many amputees from WWI and WWII increased the need for better prosthetic designs



How Do Prostheses Work?

Purpose and benefits:

- To restore functionality and capabilities of lost limb
- Enables patients to regain mobility, conduct daily living activities, keep a job

Engineering design considerations:

- Location (at a joint? cosmetic vs. functional?)
- Strength vs. weight
- Attachment method
- Available materials
- Cost

Which hand is a prosthesis? ➔

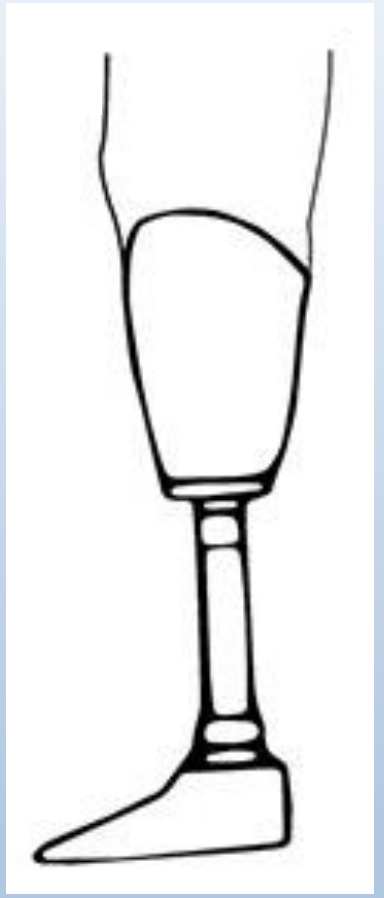
Parts of a Prosthesis

1. **Interface (socket):** Where the prosthetic device meets the remaining part of the limb

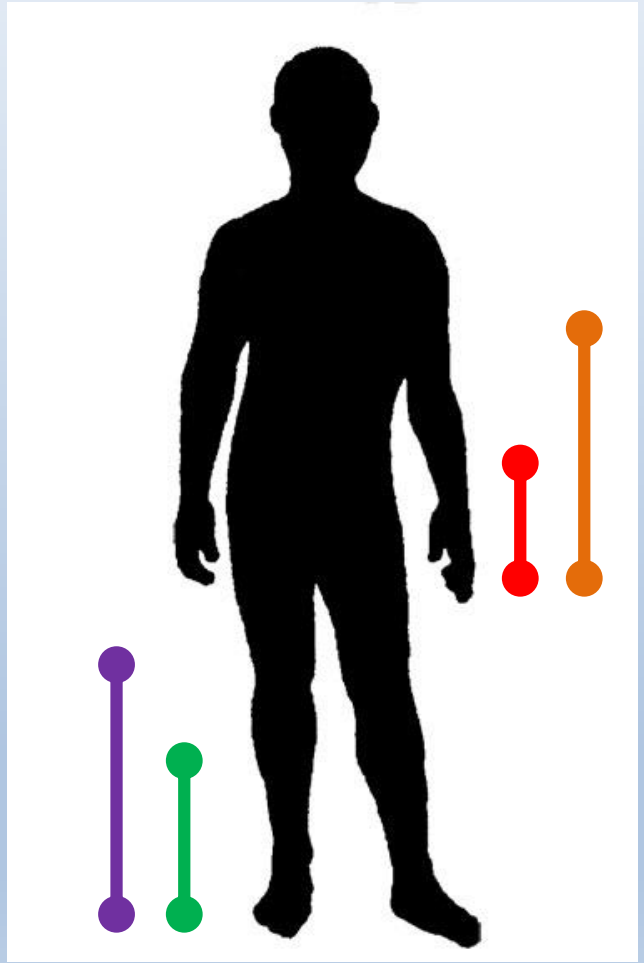
   Usually includes a suspension system that uses an attachment method:

   - A suction valve forms a seal with the limb
   - Locking pin
   - Belt and harness

2. **Components (pylon):** The internal working parts of the prosthesis
3. **Foot:** Or hand, in the case of an arm prosthesis
4. **Cover:** May be covered in a material so more lifelike



Main Types of Artificial Limbs



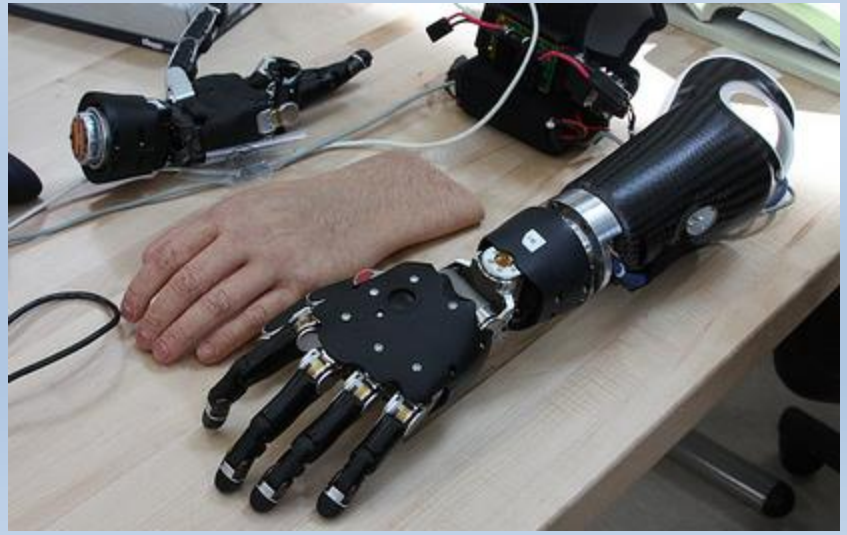
1. **Transradial:** Replaces an arm from below the elbow (includes the wrist, hand and fingers)
2. **Transhumeral:** Replaces an arm from above the elbow (includes the elbow, wrist, hand and fingers)
3. **Transtibial:** Replaces the leg from below the knee (includes the ankle, foot and toes)
4. **Transfemoral:** Replaces the leg from above the knee (includes the knee, ankle, foot and toes)

Modern Materials

Modern materials make prostheses **stronger**, **lighter** and **more realistic** in appearance and use:

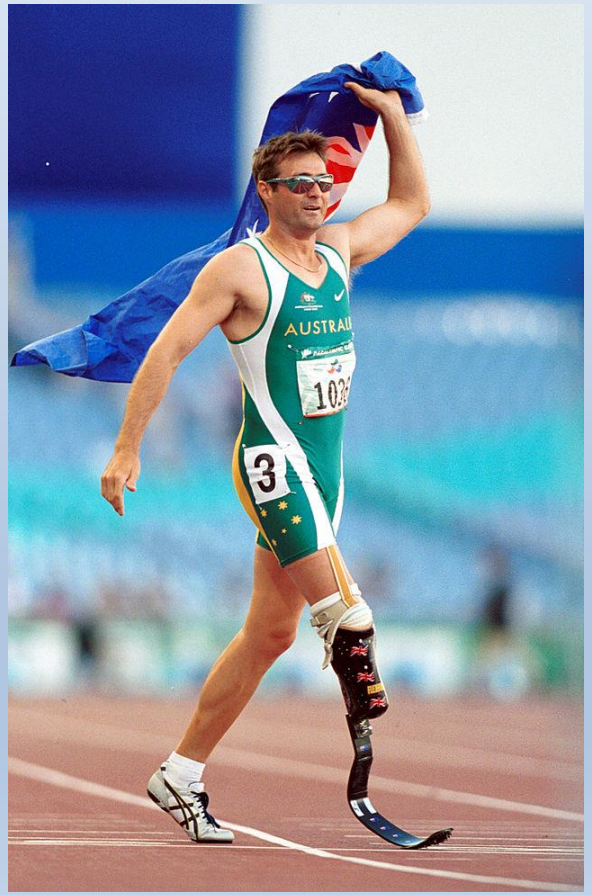
- Advanced plastics
- Carbon fiber composites
- Electronic components for control

A brain-controlled prosthetic limb➔

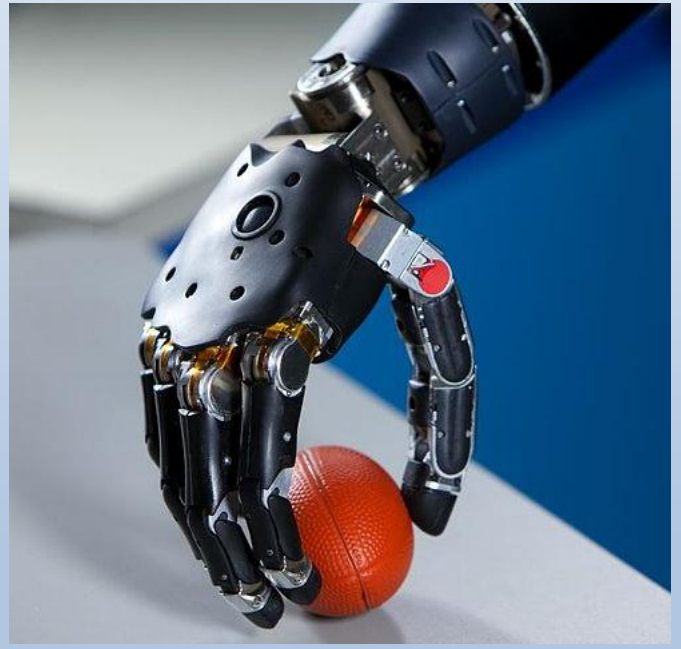


Categories of Modern Prostheses

1. Specialty

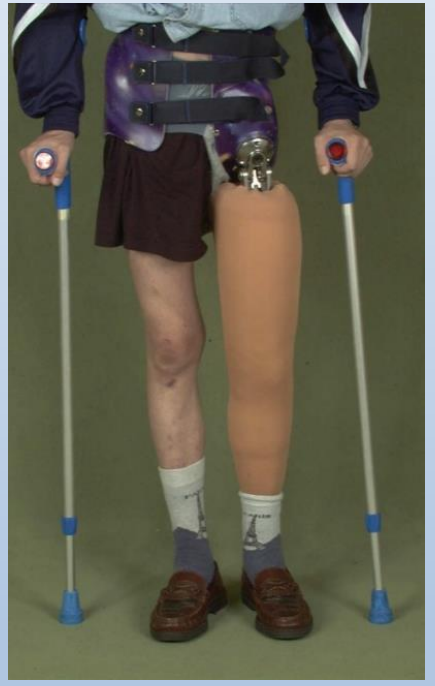


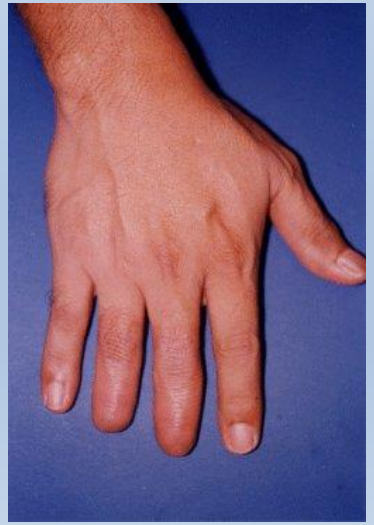
2. Functional

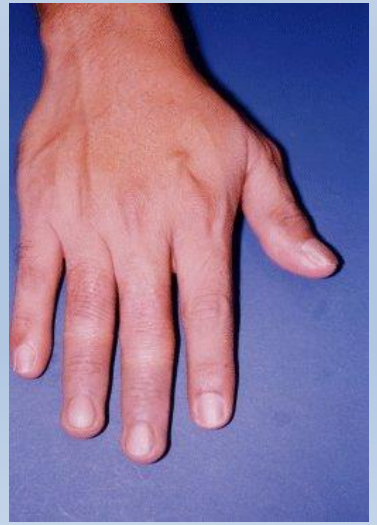


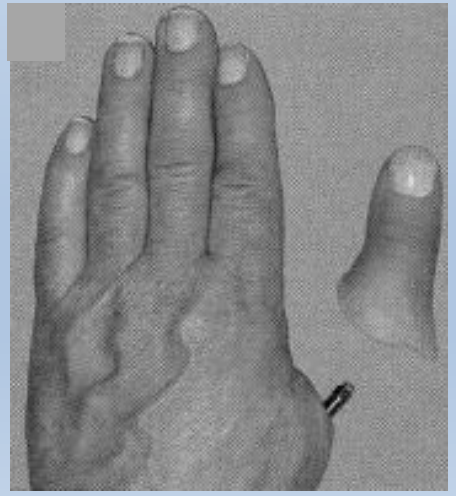
Categories of Modern Prostheses

3. Cosmetic
   - Eye
   - Fingers
   - Leg



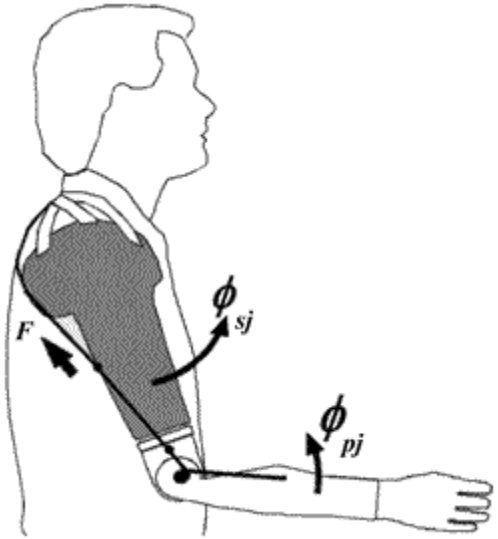


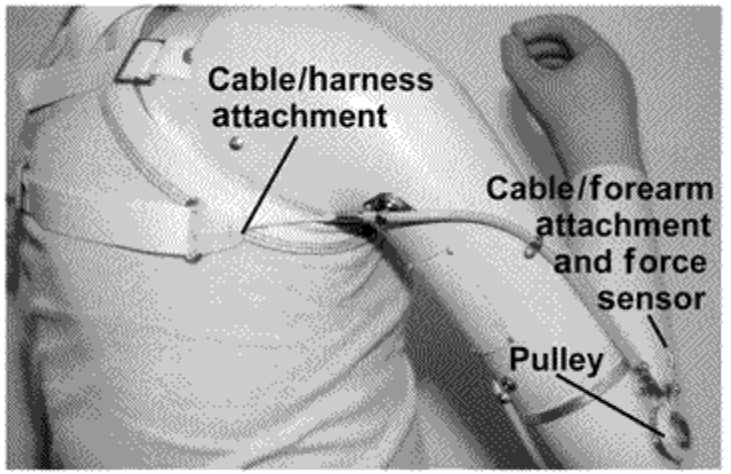




Controlling the Prosthetic

External cable/switch control systems➔





Electronic systems:

Electrodes implanted *in residual limbs* (forearm in this example) control muscle movements ➔

Electrodes implanted *into the brain* (neural implants) provide residual limb muscle control via neuron signals

Biomedical & Mechanical Engineers

Engineers apply their expert knowledge of:

- anatomy
- neurology
- biomechanics
- sensor motor control

to design prostheses and other medical devices that improve mobility and function for people