ROBOTICS AND PHYSICS

We consider some fundamental issues that arise as we move in the directions of robots that are much larger or much smaller than everyday human scale. In some interesting cases both much larger and much smaller prevail simultaneously, e.g., large networks of small devices.

Scaling was the first of the Two New Sciences revealed in Galileo’s Discourses and Mathematical Demonstrations (1638); physics was the second. Galileo understood this: “... the mere fact that it is matter makes the larger machine, built of the same material and in the same proportion as the smaller, correspond with exactness to the smaller in every respect except that it will not be so strong ... who does not know that a horse falling from a height of three or four cubits will break his bones, while a dog falling from the same height ... will suffer no injury?”

Strength:

Strength related scaling is not yet much of a problem in robotics. Big-end robots – e.g., radio telescopes – are designed by mechanical engineers who know how to build structures that only rarely collapse under their own weight . And the mechanical overdesign of the present generation of small-end robots – e.g., prototype fly-on-the-wall nano-robot spies – does not significantly decrease their already miniscule functionality.

Energy:

The most serious scaling problem for present day robotics relates not to strength but to energy. The temporal endurance of any machine is its stored energy divided by its minimum power requirement.

Communication:

The public is fascinated by visions of smart microrobots; the roboticists are fascinated by visions of huge armies of not-so-smart nano-robots organizing themselves into super-brains and mega-bodies that adapt themselves to any task. Robots are classically defined as machines that sense, think, and act, which eventually leads to communication.

This is possible with ROBOTICS:

Robot Vacuum Cleaner Family

We can imagine a family of robotic vacuum cleaners, all of the same design, but implemented at various scales from the huge aircraft hangar model down to the standard residential model, then further down to the mouse-sized model for cleaning under furniture, and even further down to the ant-sized model for cleaning, say, the crevices between bathroom tiles.

Ref: When Physics Rules Robotics by Mel Siegel