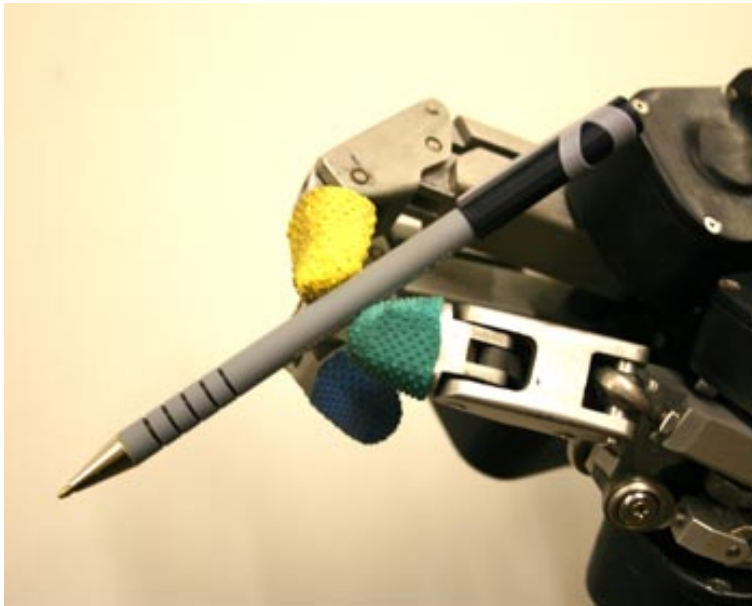




Prehensor

Traditionally, **Atmospheric Diving Suits (ADS)** – such as the ‘**JIM**’, ‘**Wasp**’, ‘**Newtsuit**’, and ‘**Hardsuit**’ – have relied on a two-jawed ‘manipulator’ in place of the human hand. This manipulator operates much like a pair of pliers: by squeezing the handles inside the ADS, a set of jaws close on an object outside of the suit. The difficulty involved in executing an underwater task that requires significant manual dexterity can be demonstrated on the surface by attempting the same task using only two pairs of pliers: with practice and good eye/hand coordination skills, the operator can perform simple tasks; with extensive experience it is possible to do some rigging, shackle-pin removal and replacement, and similar work; however, to complete complex tasks, an ADS pilot needs the ability to use his or her hands in the same manner as a Scuba or helmet diver. Until now this has not been possible.



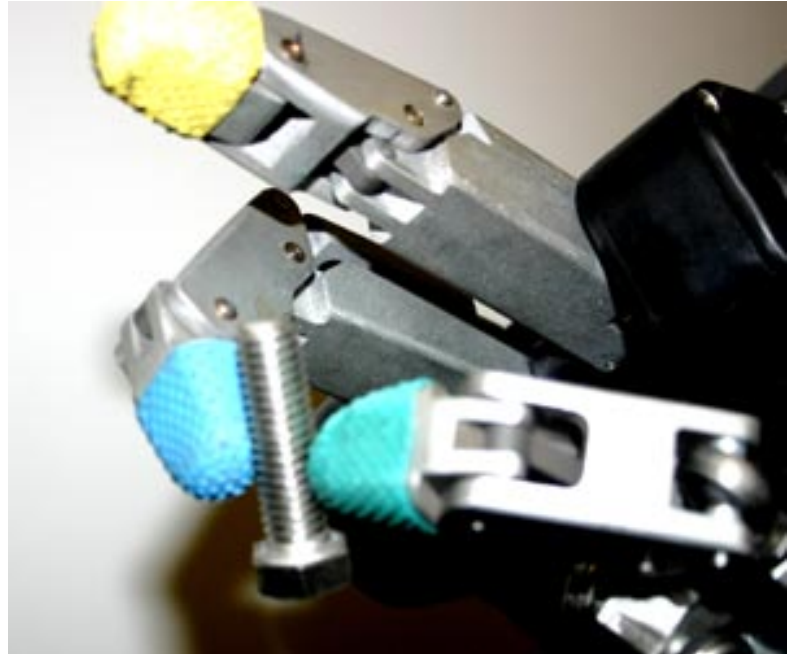
Much is made of the ‘opposed thumb’ of humans, with the suggestion that the ability to grasp distinguishes us from more ‘primitive’ animals. If it were that simple, crabs would rule the world! The kinesiology of the human hand is amazingly complex, but it comes down largely to the ability of the human thumb to ‘index’. That is, to directly oppose each of the individual fingertips, to centre itself if more than a single finger or digit is employed, as in grasping, and to do all of this reflexively, without conscious thought.

A simple experiment will serve to illustrate the point: put a pen or pencil down on a desk or table. Pick it up with your thumb and forefinger. Note that your thumb is now directly opposite your forefinger. Of course it is! If your thumb and your forefinger were offset, then the pen would simply spin out of your grasp. Try it. Now pick up the pencil again with your thumb, your forefinger and your index finger – a ‘three-jawed’ approach. Again note that your thumb automatically indexes to the centre – the space between the two fingers. Try it again with three fingers and your thumb. Same result: your thumb indexes to the centre. It is not simply the ‘opposable thumb’ that gives some primates (including humans) the ability to carry out complex manipulative tasks, it is the ‘indexable’ thumb!



Prehensor

The development of an ADS manipulator, or end-effector, that could match or nearly match the dexterity of a gloved hand would require that the external 'fingers' not only mimic the exact movements of the inside 'master' hand, but also provide full, 100% reflexive index-ability of the external thumb, in concert with the number of other digits employed. In addition, the outside 'slave hand' should also provide directly proportional sensory feedback of pressure, weight, etc., to the inside master hand (yours!).



Previous attempts to build such a device have achieved reasonably close mechanical matches to the geometry and motion of the individual phalanges of the fingers, but the designers and engineers were not able to provide a true, rotating, index-able thumb to oppose those fingers.

The Nuytco '**Prehensor**' does just that. Pick up a ball, throw it against a wall, and catch it on the rebound. Pick up a pen and sign your name on a piece of paper. Pick up a nut with the tips of the thumb, forefinger and index finger, start it on a bolt in exactly the same manner that you usually do, then spin it up the flange with one finger before you pick up a wrench to tighten it.

The unique capabilities of the '**Prehensor**' were developed specifically with the **Nuytco ADS 'Exosuit'** in mind, but the system can easily replace existing simple jaw-style manipulators for use on ADS units. Completed prototypes currently are undergoing exhaustive beta testing before limited production begins. An electronically-controlled version is under development for use on remotely operated vehicles (ROV's) and deep submersibles. There also is considerable interest and discussion with the national space agencies of several countries on the use of the '**Prehensor**' as a possible alternative to the conventional space-suit gloves.

Nuytco has produced a DVD showing the stages of evolution of the '**Prehensor**' and examples of different versions working on various tasks. Copies of this DVD are available to qualified potential users. Please contact us with a brief description of your company and intended use.

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