Is Robotics useful for Rescue Operation?

Tokyo Institute of Technology

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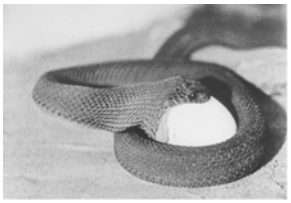
OUTLINE

- Introduction of Robotic research in Hirose/Yoneda Laboratory of Tokyo Tech.
  - snake robots
  - walking robots
  - crawler robots
  - demining robots
- Rescue Robots

Why snake?

Leg



Hand

Snake-like robots can be:

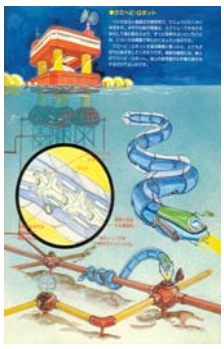
Active Rope

Active Endoscope

Off-the-road Vehicle

Snake-like robots can be:

Active hose



Amphibious Vehicle

"ACM-R3"

Spec. (21 units)

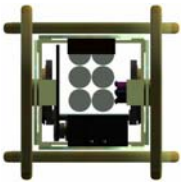
D.O.F.: 20
Length: 1755[mm]
Width: 110 [mm]
Height: 110 [mm]
Weight : 12.1[kg]

Concepts:

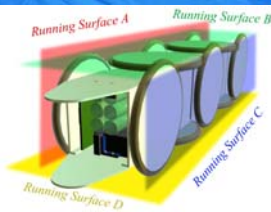
- 3D mobile Active Cord Mechanism
- Wide application for disaster relief
- Platform of 3D mobile snake-like robot

For TITech/COE Super Mechano-Systems project and all snake-like robot researchers

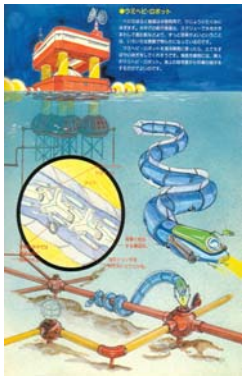
- Wheels wrap the body overall
  - Units have frictional characteristics as snake skin
  - Units can move narrow space



A cross section



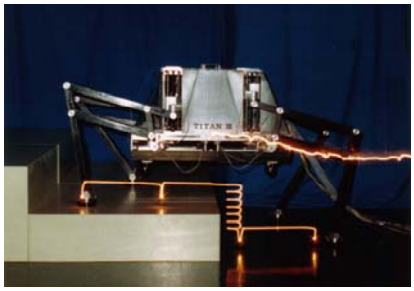
Development of Swimming Snake-Like Robots



Previous Experiment at the Swimming Pool of Tokyo Tech.
April 23, 2005

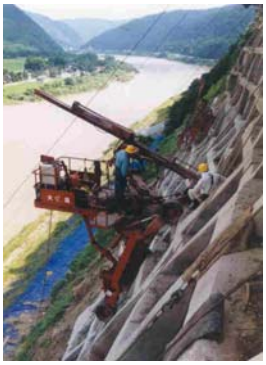
Swimming Snake Robot

Walking Robot



Quadruped Walking Robot
for the Construction Operation on Steep Slope

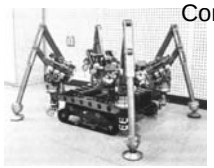
Walking Robot for Steep-Slope-Construction Task



TITAN VII

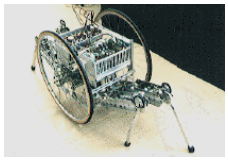
Walking Robot for Steep-Slope-Construction Task

Leg Wheel Hybrid Vehicles : Conventional



Underground Excavating Machine
(Mechanical Engineering Laboratory, AIST, MITI)

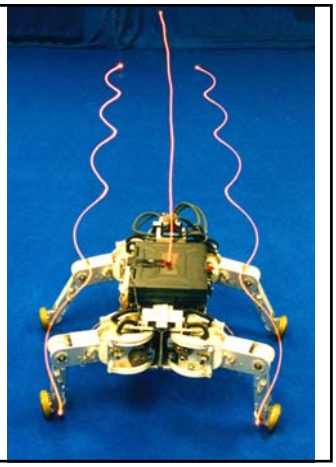
Disaster-Prevention Robot (KOBE STEEL Ltd.)



Chariot II (Tohoku University)

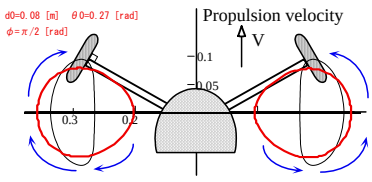
TITAN IV (Tokyo Institute of Technology)

Roller-Walker



Optimized leg trajectory

skate edge motion



$$\begin{cases} d(t) = d_{offset} + d_0 \left(\sin\left(\frac{2\pi}{T} t + \frac{3}{2}\pi \right) + 1 \right) \\ \theta(t) = -\theta_0 \sin\left(\frac{2\pi}{T} t + \frac{3}{2}\pi + \phi \right) \end{cases}$$

TAQT Carrier
(1991, Takaoka Co.)

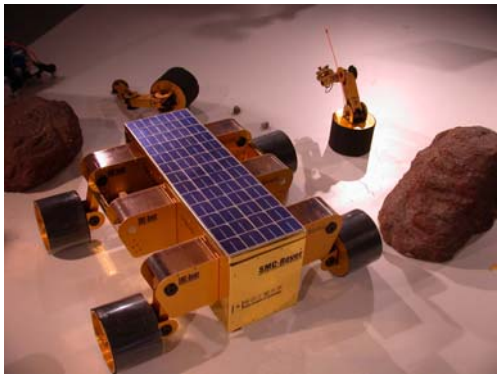



The robots developed after the JCO accident (2001)

Criticality Accident at the Uranium Conversion Facility occurred on September 30, 1999 in JCO Co.Ltd.
Mitsubishi Heavy Industry manufactured MARS, where two of my patents of the HELIOS were licensed.


Tr-Star II

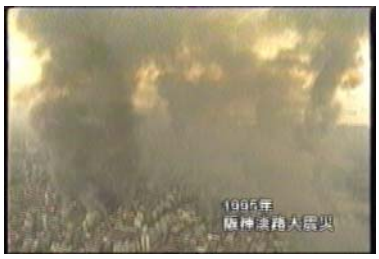
SMC rover



Rescue Robots

The Great Hanshin-Awaji Earthquake

5:46 a.m. January 17,1995
Deceased 6,401

No robots were used for the rescue operation!

World Trade Center

CRASAR: Center for Robot-Assisted Search and Rescue

Rescue Robots

Snake

Souryu-III

HELIOS VII

Rescue Robots

HELIOS VII

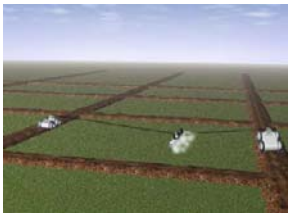
Rescue Devices

Hyper-Tether

Examples of Field-Work Applications

Cooperation with other robots

Grass-cutting, landmine detection



Spraying of agricultural chemicals

Tether Launching Device and Flying Gripper

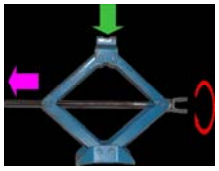
Catching and releasing mechanism of Flying Gripper

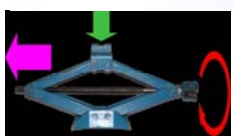
Off-the-road crawler HELIOS-VI with Flying Gripper

Improved Automobile Jack usable for rescue operation

Jack was effectively used for rescue operation in Hanshin-Awaji great earthquake.

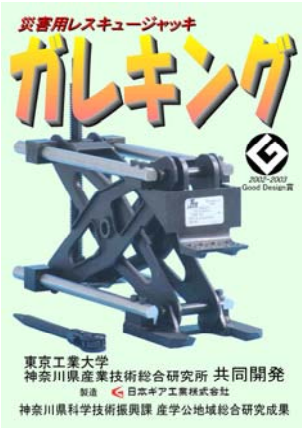
But it is difficult to insert in narrow space and it can not produce large force in flat posture





Loading experiments of the X-Jack

Produced more than 10,000 N



Jack for rescue operation

"GAREKING"

Good Design Award

2002-2003

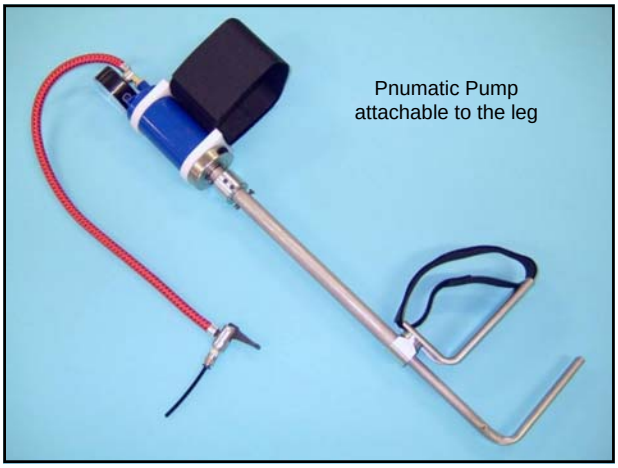
Japan Gear Co.Ltd.

Cooperative development

Tokyo Institute of Technology

Kanagawa Industrial Technology Research Institute (KITRI)

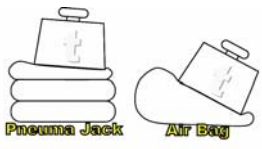
Wearable air-pump for bike: It can be used for rescue operation too



Pnumatic Pump attachable to the leg

ほぼ完成した足踏み式空圧ポンプの概観

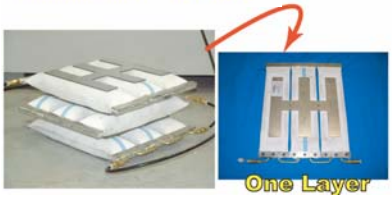
Pnuma Jack



•安価で耐圧性に優れる消防ホースで構成

•ホースを平面状に配置して一層を形成し，これを層状に組むことで，天板の傾斜を最小にする．

•一層ごとに分離可能なため，災害現場に応じて上げ幅を調節することができる．



動作実験

ニューマジャッキ 仕様	
全長	420[mm]
全幅	400[mm]
全高	80[mm]
質量	11.6[Kg]
最大上げ幅	243[mm]
最大荷重 (0.3[Mpa]	10[KN]

What we are doing now in Hirose Yoneda Laboratory