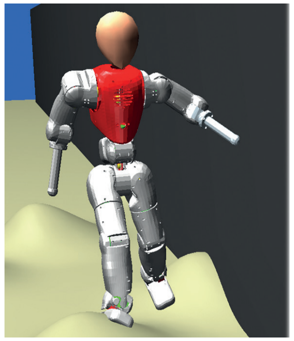
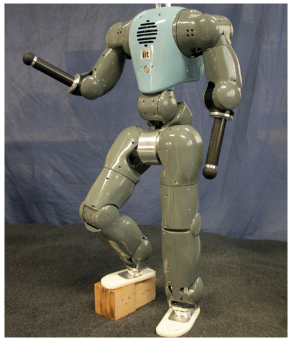
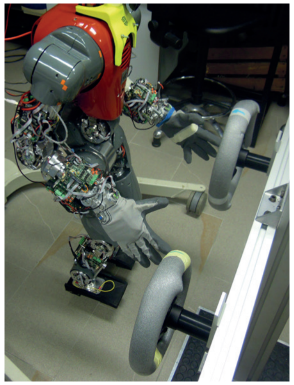
CONSORTIUM







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CONSORTIUM

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WALK-MAN

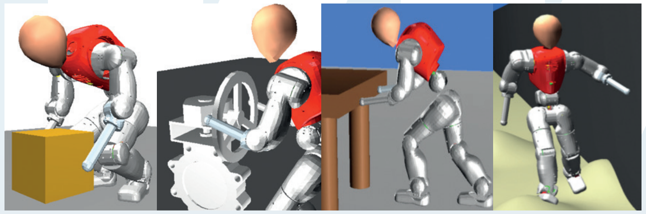
www.walk-man.eu

SUMMARY

WALK-MAN aims to develop a humanoid robot that can operate in realistic and challenging workspaces such as buildings that were damaged following natural and man-made disasters.

The robot will demonstrate new skills:

- dextrous, powerful manipulation skills: e.g. turning a heavy valve of lifting collapsed masonry
- robust balanced locomotion: walking, crawling over a pile of debris
- physical sturdiness: e.g. operating conventional hand tools such as pneumatic drills or cutters
- the robot will show human levels of locomotion, balance and manipulation and operate outside the laboratory environment

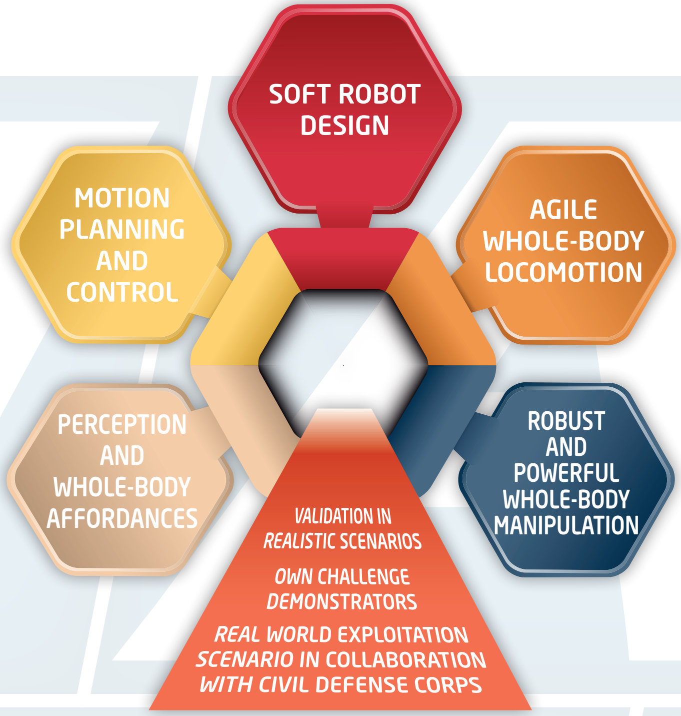


To achieve these goals, we will develop four powerful enabling ideas:

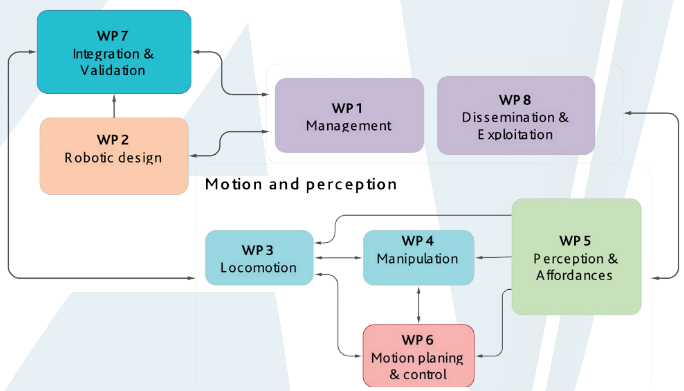
- an integrated approach to whole-body locomotion and manipulation (termed loco-manipulation), where all body parts (arms, hands and legs) can be used to ensure stable and balanced motion and to produce large manipulation forces needed in a disaster environment;
- the development of a system of loco-manipulation behaviours that control the robot's perception, cognition and action
- the use of soft, compliant actuator technologies, to provide more natural adaptability, interaction and robustness
- efficient planning algorithms exploiting a robust and consistent control hierarchy based on the theory of motion description languages and symbolic control

To ensure the goals are realistic and achievable, we will define strict, real world validation scenarios Our ultimate goal is that, when the need will (unfortunately) arise again, robotics will up to the challenge.

OBJECTIVES



WORKPLAN



RESEARCH DIRECTIONS

Soft robot design for a robust and powerful humanoid

To explore and implement the complex interactions among the robot physical body, control system, motion generation and interaction and combine and tune the capacities in the robot design (including passive and active compliance control) with a novel and highly integrated model-based control approaches.

Agile whole body locomotion

To develop reactive and versatile leg skills to permit humanoids to walk and balance against external disturbances. To advance from the slowly adaptive pre-planned bipedal gait generators and balancing planners towards more rapidly modulated and planning-free cyclic pattern generators combined with reflexive behaviours that will allow the robot to cope with uneven terrains and rapid start and stop gait transitions.

Robust and powerful manipulation

To develop hands that can perform powerful grasping and manipulation of human designed tools and interfaces, exhibiting mechanical robustness and power performance while maintaining significant capabilities to adapt to features of the environment. To integrate intrinsic flexibility in the hand design and combine it with controlled reactive impedance regulation during task execution to improve grasping stability and manipulation tolerance to object and interaction uncertainties.

Environment perception and whole-body affordances

To develop methods for multi-modal environment perception and active exploration combining the robot's haptic sensing capacity during interactions and contacts, multiple inertial measurement sensors and exteroceptive vision data, to create 3D model representations of the environment and to associate affordance to environmental elements.

Motion planning and control

To develop efficient algorithms for anytime planning and control of loco-manipulation, exploiting available primitives for locomotion, grasping, and manipulation when possible, and designing ad-hoc motions (or new primitives) as needed. The planning approach will ensure safety of the robot, by disallowing motions from which the robot cannot safely recover using, e.g., pre-defined "emergency" primitives, or by "rolling back" to previously known safe conditions.

Validation using realistic scenarios

To integrate results and validate the robot locomotion and manipulation capabilities in real task scenarios. To ensure concreteness and realism of our results in challenging, independently proposed scenarios. To ensure relevance to real world application, and ultimately readiness in case of need for use by Civil Defence Corps.