Drones and Autonomous Systems Lab @ UNLV

Transformer Darwin (#001)

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Annotated bibliography

Darwin-OP (Spring/Summer 2017)

Drones and Autonomous Systems Lab @ UNLV

Paper one: Humanoid navigation with dynamic footstep plans

Web-link: http://ieeexplore.ieee.org/abstract/document/5979656/

Citation: Garimort, J., Hornung, A. and Bennewitz, M., 2011, May. Humanoid navigation with dynamic footstep plans. In *Robotics and Automation (ICRA), 2011 IEEE International Conference on* (pp. 3982-3987). IEEE. **This paper has been cited 41 times**

Reader Description:

Time to read/comment/highlight the full paper: *3 hours and 35 minutes*

This paper ***describes a navigation method called Lite D* applied to Aldebaran NAO***. The big picture that motivates this paper is ***to develop an optimal footstep planning with an efficient collision detection and obstacle voidance***. The critical gap the paper tries to fill is/are ***account for motion drift and determine the robot's pose in a 3D world model***. The approach used is: ***to use the manufacture's walking engine (Inverted Pendulum model) "footstep model"; Elaborate an incremental heuristic search algorithm(an extension of A* method); change the starting states of the D* lite code for a faster re-planner; Using a 2D grip map (Despite the fact that they mentioned 3D at the beginning of the paper)***. This approach's background stems from: ***local planner suggested by Okada[10]; global 2D path suggested buy Elmogy [11][12]; footstep basis using A* argued by Chestnutt[13]; ZMP-based pattern generator suggested by Kanehiro [15]; probabilistic planner [16]*** . The paper presents ***heuristic functions models(D* Lite) (equations very unclear to follow, because my lack of knowledge), computer simulations (software not disclosed), experiments with NAO and a full sized humanoid (Honda's ASISMO; PS: allows step over obstacles)***. The selection ***of (D* Lite) is because such method has been extensively used for robotics navigation stems*** based **on the DARPA Grand Challenge [17]**. The results suggest that ***the humanoid can correct small deviations from the original footstep, therefore quickly re-planning its steps to avoid obstacles***. The paper concludes with ***an efficient way to plan motions for humanoid robots while***

scanning the environment and responding to any barrier that it might encounter. The authors ***mentioned to extend their planning method to a 3D environments for the future studies***.

Time to complete the description above: *1 hour and 23 minutes*

Reader's commentaries:

The paper is very well written, but the math and the equations are very hard to understand. The paper flows nicely with a clear progressive thoughts (INTRO->RELATED_WORK->METHOD_CHOSEN-.RSULTS->CONCLU). I did not understand this paper from "top to bottom", however I have gathered the main idea of it.

PS: The full reviewed paper is attached at APENDIX-A. Due to copyrights policy such appendix ought to be used exclusively by the reader and the reader's advisor.

Paper Two: Integrated Perception, Mapping, and Footstep Planning for Humanoid Navigation Among 3D Obstacles

Web-link: http://ieeexplore.ieee.org/abstract/document/6696731/

Citation: Maier, Daniel, Christian Lutz, and Maren Bennewitz. "Integrated perception, mapping, and footstep planning for humanoid navigation among 3D obstacles." *Intelligent Robots and Systems (IROS), 2013 IEEE/RSJ International Conference on*. IEEE, 2013.**This paper has been cited 23 times**

Time to read/comment/highlight the full paper: 5 *hours and 19 minutes*

This paper ***describes a real-time footstep planning method for applied to Aldebaran NAO***. The big picture that motivates this paper ***is to propose a combination of several methods and hardware that alongside with simulations and experimentation***. The critical gap the paper tries to fill is/are ***account for a method which allows humanoid robots to autonomously navigate into unknown environments***. The approach used is: ***to apply several techniques to accomplish an integrated navigation framework based on a combination of: pose estimation, mapping, and motion planning for autonomous navigation in unknown 3D environments.; use Aldebaran NAO for modifiable walking patterns***. This approach's background stems from: ***footstep planning (plus 3D obstacles) suggested by Perrin [7]; camera images to plan footsteps by Cupec [12] track objects in monocular images suggested by Michel [13]; 3D occupancy grid based argued by Gutmann [14]; a laser scanner mounted on a humanoid robot for environment mapping studied by Niwshiewaki*** . The paper presents ***a combination of odometry with depth measurements, forward kinematics, and onboard IMU(inertia measurement unit) for "pose estimation"; a high-resolution heightmap for environment representation; inverse heightmap (IHM) for collision check; ARA* method for footstep planning, experiments with NAO .***

The selection ***of the methods mentioned above were chosen due their unique capability of effectively and autonomously walk into cluttered environments. The results suggest that***. The paper concludes ***that the first system that combines these techniques in a unique framework.***

. The authors ***did not mentioned future studies***.

Time to complete the description above: *1 hour and 34 minutes*

Reader's commentaries:

The paper has a tremendous structure(I will use it as template). It also combines a lot of advance computer science, most of the information on this paper is brand new to me. I have no clue how the authors are able to get those types of simulation.

PS: The full reviewed paper is attached at APENDIX-A. Due to copyrights policy such appendix ought to be used exclusively by the reader and the reader's advisor.

Paper Three: Real-time Footstep Planning and Following for Navigation of Humanoid Robots

Web-link:
http://www.jeet.or.kr/LTKPSWeb/uploadfiles/be/201507/270720151457568285000.pdf

Citation: Hong, Young-Dae. "Real-time footstep planning and following for navigation of humanoid robots." J. Elect. Eng. Technol 10.5 (2015): 2142-2148.**This paper has been cited 5 times**

Reader Description:

Time to read/comment/highlight the full paper: *4 hours and 08 minutes*

This paper a integrate navigation system ***describes a real-time footstep planning method for applied to DARwIn-OP***. The big picture that motivates this paper ***is to propose a method that is effective and verified by experimentation and simulation***. The critical gap the paper tries to fill is/are ***account for a novel real-time real-time footstep planning and following methods for the navigation***. The approach used is: ***to apply the so-called "evolutionary optimization algorithm" to plan the optimal footstep sequences; use DARwIn-OP walking engine (Inverted Pendulum model) for modifiable walking patterns; use the uni-vector field method for walking direction***. This approach's background stems from: ***uni-vector field method suggested by kim [10]; walking pattern generator based on the 3-D LIPM suggested buy Lee [12]*** . The paper presents ***uni-vector field navigation method is utilized for walking direction, computer simulations (Webots, very little information on how was done though), experiments with DARwIn-OP .***The selection ***of the uni-vector field method is because it allows real-time owing to using low computing power*** based **on the previous work presented by Kim [10]**. The results suggest that "***the humanoid robot successfully arrived at the goal without obstacle collisions following the planned footsteps in real-time"[Hong]***. The paper concludes ***that the proposed method yielded satisfactory results based on expereiments and simulations.***

The authors ***did not mentioned future studies***.

Time to complete the description above: *55 minutes*

Reader's commentaries:

The paper is not helpful in terms of "explaining the physics and mathematics" behind the method proposed. I am sure that I cannot reproduce what the author has done, however I also cannot argues with the overall logic of the paper. There is almost nonexistent mention regarding the simulation.

PS: The full reviewed paper is attached at APENDIX-A. Due to copyrights policy such appendix ought to be used exclusively by the reader and the reader's advisor.

Paper Four: Self-supervised obstacle detection for humanoid navigation using monocular vision and sparse laser data

Web-link:

http://ieeexplore.ieee.org/abstract/document/5979661/

Citation: Maier, Daniel, Maren Bennewitz, and Cyrill Stachniss. "Self-supervised obstacle detection for humanoid navigation using monocular vision and sparse laser data." Robotics and Automation (ICRA), 2011 IEEE International Conference on. IEEE, 2011.**This paper has been cited 26 times**

Reader Description:

Time to read/comment/highlight the full paper: *3 hours and 42 minutes*

This paper a integrate navigation system ***based on monocular images and sparse laser range data and obstacle detection for collision-free***. The big picture that motivates this paper ***is to propose a technique to train obstacle detectors for images obtained from a monocular camera and verified by experimentation and simulation***. The critical gap the paper tries to fill is/are ***avoid the risk of collisions while walking by using monocular images and sparse laser date***. The approach used is: ***NAO continuously receives 2D range data from the laser sensor by learning classifiers using the laser data to automatically generate training data to avoid obstacles; "planning the motion of the robot using 2D occupancy grid map to combine the laser data as well as traversability information from the classified camera data" [Maier].*** This approach's background stems from: ***model-based technique to track individual objects in monocular images during walking suggested by Michel [12]; detect objects with given shapes and colors in monocular images Cupec [3]; Stachniss[17] suggested 2D grid maps of large environments with a humanoid equipped with a laser scanner located in the neck; Tellez[20] used two laser scanners mounted on the robot's feet; Li [11] proposed a vision-based obstacle avoidance approach for the RoboCup domain; Nourbakhsh suggested to learn color histograms of pixels corresponding to the***

floor. The paper presents ***Nao taking 3D range scan to train its classifiers, and then started navigating and updating its map based on the visual input, experiments with NAO .***The selection ***of the monocular images and sparse laser range method is because it allows an easy surface detection***. The results suggest that "***the humanoid can navigate more efficiently and avoid obstacles".*** The paper concludes ***that the proposed method offers satisfactory results based on experiments and simulations.***

The authors ***did not mentioned future studies***.

Time to complete the description above: 49 *minutes*

Reader's commentaries:

Again the physics and mathematics is very obscure to me. The paper has a kinda rusty flow. There are a lot of repetition throughout the paper. There is almost nonexistent mention regarding the simulation.

PS: The full reviewed paper is attached at APENDIX-A. Due to copyrights policy such appendix ought to be used exclusively by the reader and the reader's advisor.

Paper Five: Vision-Based Corridor Navigation for Humanoid Robot

Web-link:

http://ieeexplore.ieee.org/abstract/document/6631021/

Citation: Faragasso, Angela, et al. "Vision-based corridor navigation for humanoid robots." Robotics and Automation (ICRA), 2013 IEEE International Conference on. IEEE, 2013.**This paper has been cited 22 times**

Reader Description:

Time to read/comment/highlight the full paper: 4 *hours and 13 minutes*

This paper discuss ***control-based approach for visual navigation of humanoid robots in office-like environments***. The big picture that motivates this paper ***is the design and experimental validation of a simple and robust vision-based corridor navigation method producing natural motion for humanoid***. The critical gap the paper tries to fill is/are ***to implement a map-less method for corridor navigation with formally proved heading and position convergence***. The approach used is: "***to propose an Image-Based Visual Servoing (IBVS) to generate walking; to design a visual control scheme enabling the robot to walk as close as possible the corridor center; formulation of a gait model; generate velocity commands for a virtual unicycle robot and then convert these commands in real-time to reference velocities for the humanoid"[Faragasso].*** This approach's background stems from: ***based on localization on known maps [1] Lutz; preregistered images of the environment [3] Ido; use the visual servoing paradigm to generate walking motion of humanoids [4] Dune; a Position Based Visual Servoing [4] Dune; proposes a motion generation approach to the animation of human characters based on the concept of IBVS [5] Courty***. The paper presents ***a technique originally designed for unicycle robots and extended here to cope with the presence of turns and junctions, experiments with NAO .***The selection ***of the Image-Based Visual Servoing is because it allows the humanoid to use its own onboard camera for image data treatment***. The results suggest that "***the humanoid can navigate***

Thoughout the corridor by following the M point strategy". The paper concludes ***that the proposed method effectiveness of the extended controller in negotiating turns and junctions.***The authors ***mentioned four options future studies: image stabilization; more quantitative assessment; validation of the controller; extension of the visual***.

Time to complete the description above: 1 hour 6 *minutes*

Reader's commentaries:

The paper is relatively decent. I fell like it lacks literature review. The goal is well defined. And the math is not so obscure, although I have not fathom in its totality. There are very few references in this paper. And since they suggested four future works, I assume that this is only a preliminary work.

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