Dear Steve Tonneau, Nicolas Mansard, Chonhyon Park, Dinesh Manocha, Franck Multon, Julien Pettré,

We are pleased to inform you that your paper

Title: A Reachability-based planner for sequences of acyclic contacts in cluttered environments
Authors Steve Tonneau, Nicolas Mansard, Chonhyon Park, Dinesh Manocha, Franck Multon, Julien Pettré

has been accepted for an interactive presentation at International Symposium of Robotics Research and for publication in the Springer STAR series book with the proceedings of the International Symposium of Robotics Research.

Congratulations!!

The review process was highly selective and many good papers could not be accepted for the final program. Interactive presentations will consist of a short, plenary oral introduction, and a dedicated, in depth discussion session with audio-visual support.

The reviews of your paper are included below. Please take the comments into account when preparing the final version of your paper, which is due by August 15, 2015. Please also consider that a few among the final submissions will be selected to appear in a special issue that the International Journal of Robotics Research (IJRR) will dedicate to International Symposium of Robotics Research.

Please prepare the camera-ready copy of your paper following the format instructions as indicated in the call for papers.

The updated conference program as well as the online registration form will be available on the conference Website shortly.

Please consider that Sestri Levante in September is one of most charming places in Italy, and a preferred resort for vacation. The Conference dates are high season in Sestri. As a consequence, it is highly recommended that hotel rooms are booked as soon as possible.

Reservations are often most conveniently done directly through the Internet. The area is rich with hotels of all categories from two to five stars, but also offers many Bed & Breakfast or apartment accommodations. More information is available at http://www.isrr-2015.org/index.php/registration/accommodation.

Congratulations again, we look forward to seeing you ISRR.

Best regards,

The ISRR Program Chairs
------------- Review from Reviewer 1 -------------
-- Comments to the author(s):
This paper presents a method that decouples a complex planning problem into two: it applies a motion planning RB-PRM for the root of the robot, which results in a guiding trajectory that is then used by the algorithm EFORT to generate the contacts. In my understanding, the strength of the paper is to provide the mathematical formalization of the conditions that generate a feasible trajectory of the root, where a solution for the contacts exist, which can then be used by a contact algorithm such as EFORT.

My main issue with this paper is that although it is careful in formalizing the problem mathematically, it does not provide enough information on how one could actually implement such ideas algorithmically (apart from Eq. (5)). As a practitioner, how can one re-use and build upon the true feasibility for solving a real robotics task? The proposed method would already become much clearer with a pseudo-code, work-flow, or even with the provision of a simple toy-problem code.

The decoupled approach is convincing when considering computational complexity and time. The authors, however, do not provide concrete evidence when compared to optimization methods. The authors mention that [12, 13] takes a minute of computation, but the results in Table 1 do not seem applicable for the online generation of contact sequences as claimed in the paper. Can you compare quantitatively, under the same conditions (simulator, test scenarios, etc) how the proposed method and local trajectory optimization differ? One the same lines, the authors claim that the proposed method outperforms **any** previous acylic planner. This is a very strong claim that is not supported by theoretical/empirical evidence. No quantitative comparison with an acylic planner is shown in the evaluation.

Two sentences in the abstract seem conflicting:

"As opposed to previous approaches, this property makes it possible to assert the relevance of a guide trajectory without explicitly computing contact configurations. This property can be efficiently checked by a sample-based planner (e.g. we implemented a visibility PRM)."

Doesn't the second sentence imply that you are, in fact, explicitly computing contact configurations but in a sample-based manner?

By the end of the paper, it was still not clear how the "true feasibility" can be implemented algorithmically, and how it guarantees that a sequence of contacts can be found in C_{reach}.

The video is neat and impressive. The truck egress seems very relevant nowadays due to Darpa. However, for a robotics audience, it seems quite far from the practical reality, especially when considering perception and whole-balancing control. Experimentally, the paper would be much stronger with a simple application of the method in real hardware, even in a simplified and easy scenario.

As a minor comment, the acroynim RB-PRM is already used in the abstract, but only defined later in 1.3. The same for EFORT, which was used in the legend of fig. 1 but only defined in 1.4.

-- Summary:
The presentation and writing of the paper is clear. The simulated results are impressive. While the mathematical formalism seems correct, the paper does not provide algorithmic details making it of little value for the interested practitioner to apply and reproduce the method.
---------- End of Review from Reviewer 1 ---------------------- Review from Reviewer 2 -------------
-- Comments to the author(s):

The authors present a novel approach for acyclic contact planning in cluttered environments. The proposed scheme first samples a trajectory for the base of a robot in SE(3), and then uses the EFORT criteria to sample contacts on top of that trajectory. Although the authors' method seems like a promising beginning, the work falls short of previous work in the field in that no full trajectories for the robots are ever generated; only discrete sequences of static poses. For example, the authors' references [6], [9], [11], and [13] all actually generate continuous-time, full-body trajectories for robots.

Furthermore, the abstract of the paper makes two claims which are not well justified by the remainder of the paper. In particular, the authors state that the guide trajectory is guaranteed to be feasible, which is not clear from the description as written (see further details below). Additionally, the authors claim that the proposed method "outperforms any previous acyclic contact planner". This claim is poorly justified for two reasons: 1) other planners actually generate continuous trajectories (i.e. it is an apples-to-orange comparison), and 2) the authors do not present timing results which directly compare their approach to previous methods, anyways.

Detailed comments/issues follow:

- In section 1.2, the authors state that when sampling base poses, they avoid "explicitly computing the contacts, which is computationally not reasonable". There in fact exists prior work which computes contacts during planning, for instance the "pose certificate" approach mentioned in Zucker et al., ICRA 2010.

- Some of the motions shown here are a bit unnatural, especially for humanoids. Consider the sequence depicted in fig. 1 -- why is it necessary to maintain contacts with hands on the table to get up? Moreover, why is it necessary to re-position the right hand on the table while getting up? I don't think many people would do this.

- Claims in the introduction that the system is "real time" rely on a pre-built roadmap of the environment. This would be less valid in many real-world or current research scenarios where prior information is imperfect (consider, for instance, the recent DARPA Robotics Challenge).

- Consider replacing multiple uses of the word "stake" with "goal" - for instance, as in "The stake of this first part is to preserve..."

- The notation outlined in 1.5 is cumbersome, and gets worse as more superscripts and subscripts are introduced. Consider replacing some of the denser set / coordinate notations with pseudocode?

- Mathematically, I'm not sure what "the reciprocal of a projector" is. Define, or use standard terminology.

- It is really not clear that the smapling scheme for the guide trajectory produces a complete planner. How is it proven that poses are feasible unless contacts are defined explicitly? Is it completely impossible to find a situation where the P1 planning problem is solved, but contacts can not be identified successfully? Section 2.2 seems like an admission that this is a useful heuristic, but not a complete planner. If there was a proof in there, please make it much clearer!

- In section 3.2, the notation is again unclear. I thought q^0_i and q^0_i+1 were poses for the base in SE(3), but they are treated as vectors and subtracted to produce the vector m which is apparently in R^3. What are the dimensions of q^0, m, n, and J?

- Section 4.2 does not seem to be a "rigorous" definition of the volume W^0, as suggested in section 5. What are the ***exact***, rigorous criteria used to select s here?

- Is is important to state that generating continuous, full-body trajectories is not trivial, even if only quasi-static stability is consiered. For instance, it is possible with many robots to find a discrete sequence of statically stable poses which seem close to each other, but for which there exists no continuous path through the free configuration space due to joint limits, obstacles, or stability constraints. In practice, this really adds a third planning problem P3 to the mix -- connecting up the sequence of statically poses with trajectories. Once again, not addressing this issue makes it hard to compare this work to previous approaches, and seems to be a serious shortcoming.

-- Summary:
Although this paper shows how to begin to fold the EFORT metric from the authors previous work [19] into a general planning framework, the work does not seem to be complete. In particular, the planner only outputs sequences of static poses for the robot, as opposed to prior work (e.g. [6], [9], [11], [13]) which actually generate full trajectories. Furthermore, the authors claims of guaranteed completeness and outperforming previous planners are not borne out by the arguments and evidence presented in the paper. The paper would be much stronger if it addressed these issues.
---------- End of Review from Reviewer 2 ----------