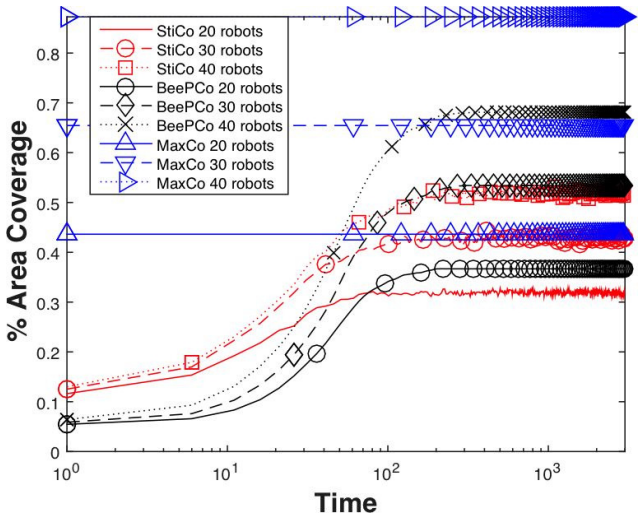


Figure 1: The percentage of area coverage using MRSs with 20, 30 and 40 robots: StiCo versus BeePCo

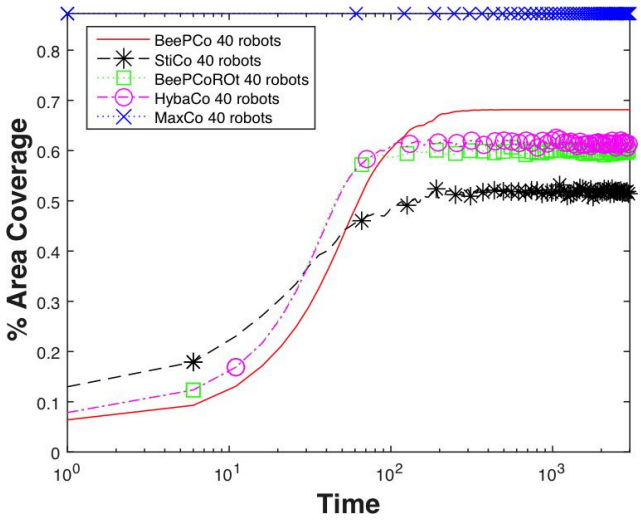
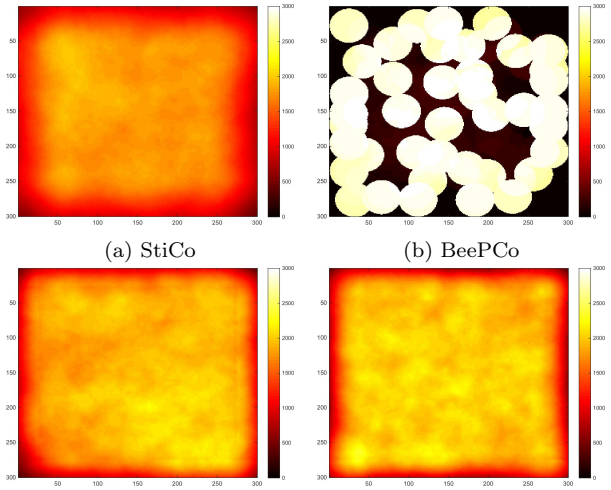


Figure 2: The percentage of area coverage using MRSs with 40 robots: StiCo, BeePCo, BeePCo with rotation and HybaCo approaches.

BeePCo with rotation: *BeePCo* extended with a rotational move; (4) ***HybaCo***: the robots use the hybrid algorithm; and (5) ***MaxCo***: the optimal case, where the robots' transmission range does not intersect with each other. This can also be referred to as *potential* coverage.

All results are averaged over 30 independent runs to assure statistical significance. We only show a selection of experiments due to page constraints. In Figure 1, the *StiCo* and *BeePCo* algorithms are compared against each other with respect to area coverage using 20, 30 and 40 robots. For both *StiCo* and *BeePCo*, we observe that the percentage of area covered increases as the number of robots increases, as expected. *BeePCo* provides considerably higher area coverage in comparison to *StiCo*.

Figures 2 and 3 illustrate the experimental results on a MRS with 40 robots and compares the performance of the *StiCo, BeePCo, BeePCo with rotation* and *HybaCo* approaches against each other in terms of the percentage of area coverage (due to space limitations, we do not show the results of the comparable experiments for 20 and 30 robots, but results are similar). These results illustrate that *HybaCo* improves performance and achieves better area coverage than the *StiCo* and *BeePCo with rotation* approaches. The distribution of the robots is illustrated using heatmaps (Figure 3). These plots show that *HybaCo* and *BeePCo with rotation* improve robot distribution and encourages robots to spread around the arena more, as opposed to the *StiCo* and BeePCo approaches. Although *BeePCo with rotation* performs worse than *HybaCo*, the improvement over the *StiCo* and BeePCo approaches is still significant.



(a) StiCo (b) BeePCo

(c) BeePCo with Rotation (d) HybaCo

Figure 3: The distribution of robots in the arena using a MRS of 40 robots on different techniques.

5. CONCLUSIONS

We have shown the performance of *StiCo*, *BeePCo* and *HyBaCo* in regard to a number of criteria, including area coverage, uniformity of distribution and speed of convergence, and we also developed a hybrid bee-and-ant inspired approach that merges the strengths of *StiCo* and *BeePCo* into one algorithm. The advantages and disadvantages of these two techniques have been highlighted. In the second set of experimental results, we evaluated the effectiveness of the proposed hybrid bee-and-ant inspired approach, i.e., *HybaCo* and reported our observations.

6. REFERENCES

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