Wireless Control of Micro-Sized Magnetic Agents

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Recent technological advances in micro-sized magnetic agents navigating in low Reynolds number fluids open new possibilities for biomedical research, such as: (1) high-precision manipulation of microbiological systems, (2) measurement of} physical variables at microscopic scale, and (3) transmission of energy in a highly localized manner (e.g., supervised tissue hyperthermia). Moreover, these wirelessly controlled agents might offer additional advantages in terms of reduced invasiveness and untethered access to deep-seated regions within the human body.

However, improvements in terms of biocompatibility, performance, robustness, safety and power efficiency of the robotic

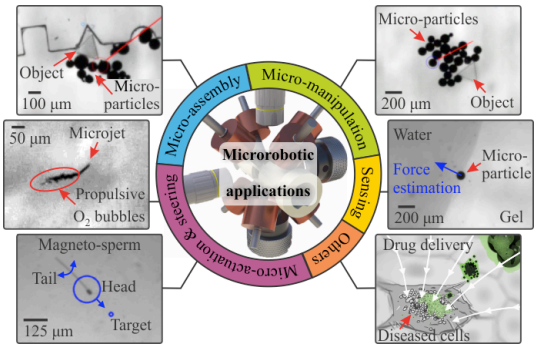

Figure 1. Examples of microrobotic applications of magnetic agents, including manipulation and assembly operations, as well as other sensing, actuation and clinical tasks (e.g., drug delivery) that can be performed using particles and other novel types of micro-sized agents.

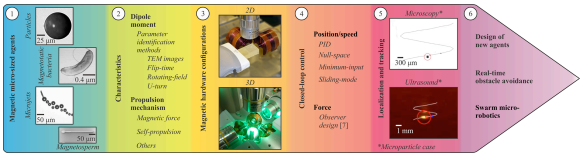

Figure 2. Main topics that are covered regarding the wireless control of micro-sized magnetic agents.

platforms are still under investigation. On that account, the most recent techniques being studied are detailed herein[1-4], including: (i) identification methods for the agent's dipole moment, (ii) different types of controllers that have been employed, (iii) ultrasound tracking of magnetic agents, (iv) real-time obstacle avoidance and (v) control of} independent swarms of magnetic agents within the same workspace.

References

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[3] Khalil *et al.*,"Closed-loop control of magnetotactic bacteria", **International Journal of Robotics Research**, 32(6): 636-648, 2013.

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