In Figure 7 straight setpoint manipulation is presented. With the $\tilde{U}_y$ differential-drive rotating-moment control authority disabled a straight trajectory cannot be ensured, as numerous uncertain parameters (object-COM position, ground texture) are crucial to the evolution of a non-ideal conditions experiment. In the first sequence it is noteworthy that the obstacle encounters higher-friction areas (near $t \simeq 20$ s and $t \simeq 22.5$ s where the U_x command is increased), with no significant disturbance induced on the hovering attitude pose.

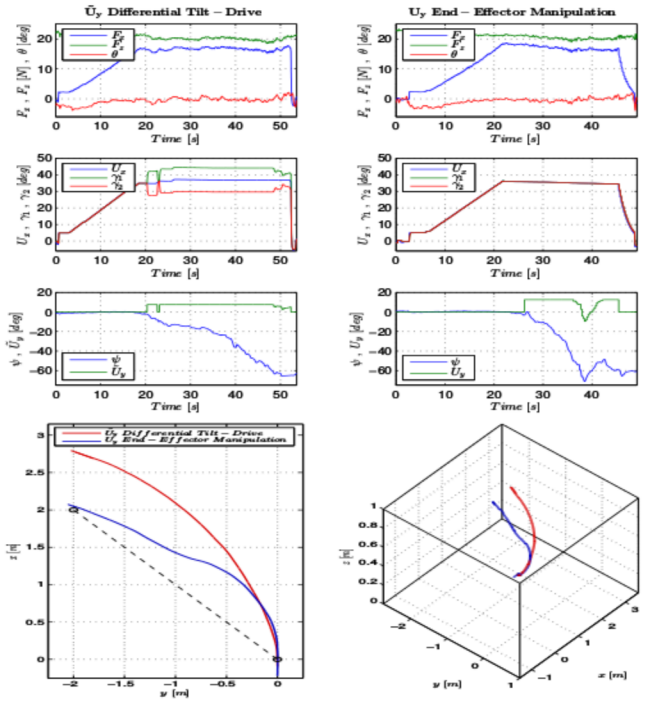

Fig. 8. Diagonal Setpoint Manipulation

In Figure 8 diagonal setpoint manipulation is presented, employing the $\tilde{U}_y$ differential-drive and the U_y end-effector manipulation principles. In these sequences, the Supervisory FSM controller maintains the reference signal until the setpoint y^r-coordinate has been reached. This provides the intuitive visualization of the effectiveness of each principle: The differential-drive moment control authority is insufficient for larger required moments, which in the object setpoint manipulation case-study appears as a large x^r overshoot.

The utility of direct thrust-vectoring as a technical asset in applications that require the exertion of large forces is noteworthy. The UAV manipulates its rotor-tilting authority up to $\gamma_x \simeq 45°$. At the same time, contrary to an underactuated system, it successfully remains near the hovering attitude pose where operational safety lies at maximum.

VI. CONCLUSIONS

An innovative implementation for the direct thrust-vectoring actuation authority of tiltrotor UAV types was

hovering pose. Additionally, two methodol
oped in order to enact a rotating moment,
differential rotor tilting, or a separate ac
This strategy's increased efficiency, in term
versus-operational safety, was analyzed in
tion. Finally, the proposed approach wa
validated on a mockup scenario, where an
the mass of the aerial platform was success
via docked maneuvering while pushing.

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