

with actuator saturation or modeling/measurement uncertainties, MAVs can land safely. Landings of this nature may have a higher velocity than is desirable, but this can be compensated for by a cushioning or dampening system,

or by using a system of legs to grab onto a surface.

Such a monocular camera system can increase vehicle payload size (or correspondingly reduce vehicle size), increase speed of descent, and guarantee a

safe landing by directly correlating speed to height from the ground.

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## Quantum-Classical Hybrid for Information Processing

**This innovation allows the coordination and synchronization of robots at remote distances.**

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Based upon quantum-inspired entanglement in quantum-classical hybrids, a simple algorithm for instantaneous transmissions of non-intentional messages (chosen at random) to remote distances is proposed. The idea is to implement instantaneous transmission of conditional information on remote distances via a quantum-classical hybrid that preserves superposition of random solutions, while allowing one to measure its state variables using classical methods. Such a hybrid system reinforces the advantages, and minimizes the limitations, of both quantum and classical characteristics.

Consider  $n$  observers, and assume that each of them gets a copy of the system and runs it separately. Although they run identical systems, the outcomes of even synchronized runs may be different because the solutions of these systems are random. However, the global constraint must be satisfied. Therefore, if the observer #1 (the sender) made a measurement of the acceleration  $v_1$  at  $t=T$ , then the receiver, by measuring the corresponding acceleration  $v_1$  at  $t=T$ , may get a wrong value because the accelerations are random, and only their ratios are de-

terministic. Obviously, the transmission of this knowledge is instantaneous as soon as the measurements have been performed. In addition to that, the distance between the observers is irrelevant because the  $x$ -coordinate does not enter the governing equations. However, the Shannon information transmitted is zero. None of the senders can control the outcomes of their measurements because they are random. The senders cannot transmit intentional messages. Nevertheless, based on the transmitted knowledge, they can coordinate their actions based on conditional information. If the observer #1 knows his own measurements, the measurements of the others can be fully determined.

It is important to emphasize that the origin of entanglement of all the observers is the joint probability density that couples their actions. There is no centralized source, or a sender of the signal, because each receiver can become a sender as well. An observer receives a signal by performing certain measurements synchronized with the measurements of the others. This means that the signal is uniformly and simultaneously distributed over the observers in

a decentralized way. The signals transmit no intentional information that would favor one agent over another. All the sequence of signals received by different observers are not only statistically equivalent, but are also point-by-point identical. It is important to assume that each agent knows that the other agent simultaneously receives the identical signals. The sequences of the signals are true random, so that no agent could predict the next step with the probability different from those described by the density.

Under these quite general assumptions, the entangled observers-agents can perform non-trivial tasks that include transmission of conditional information from one agent to another, simple paradigm of cooperation, etc. The problem of behavior of intelligent agents correlated by identical random messages in a decentralized way has its own significance: it simulates evolutionary behavior of biological and social systems correlated only via simultaneous sensing sequences of unexpected events.

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## Small-Scale Dissipation in Binary-Species Transitional Mixing Layers

**This method enables cost-effective modeling for supercritical conditions prevailing in gas-turbine and liquid-rocket engines.**

*NASA's Jet Propulsion Laboratory, Pasadena, California*

Motivated by large eddy simulation (LES) modeling of supercritical turbulent flows, transitional states of databases obtained from direct numerical simulations (DNS) of binary-species supercritical temporal mixing layers were examined to understand the subgrid-scale dissipation, and its variation with filter size. Examination of the DSN-scale do-

main-averaged dissipation confirms previous findings that, out of the three modes of viscous, temperature and species-mass dissipation, the species-mass dissipation is the main contributor to the total dissipation. The results revealed that the percentage of species-mass by total dissipation is nearly invariant across species systems and initial conditions.

This dominance of the species-mass dissipation is due to high-density-gradient magnitude (HDGM) regions populating the flow under the supercritical conditions of the simulations; such regions have also been observed in fully turbulent supercritical flows. The domain average being the result of both the local values and the extent of the HDGM