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Jim Peters Plenary Lecture
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Wildland fire spot ignition and subsequent growth

Abstract: Wildland fires are becoming more frequent all around the world in a drier climate. Some of these fires may have catastrophic consequences with extensive damage to land, property, ecosystems, and lives. It is expected that under the drier weather patterns related to overall climate change, the problem will only intensify. Wildland fires are often initiated by small ignition sources (spot fire ignition) either caused by human intervention or by natural events. These ignition sources could be hot metal particle/sparks, embers, pilot flames, lightning, all of which cause a small and localized area of wildfire ignition that subsequently spreads to wider and larger areas. Sparks can be generated by power line interaction, hot work (welding, grinding, friction), ejected from the generating source, and transported forward by the wind landing on vegetation where they can start a wildland fire. Once the wildfire has been ignited it may grow exponentially by surface fire spread, and can also propagate rapidly through ember spotting, where embers are lofted by the plume of the fire and then transported forward by the wind and igniting spot fires downwind. The development of a wildland fire can be separated into ignition, initial fire growth and large-scale propagation. The spotting ignition and the subsequent initial spread of fire is a complex problem involving multiple physicochemical processes in the solid and gas phases. These processes depend on many factors, including: the generation of the particles; the size and thermo-chemical state of the particles (inert or burning); the trajectories of the particles from their generation to their landing; characteristics of the shower of particles (dense or light) at landing; the fuel bed where they land (fuel type, porosity, moisture content, temperature); environmental conditions (temperature, humidity, wind velocity). By characterizing these distinct individual processes, it is possible to attain the required information to develop predictive, physics-based wildfire spotting models. The models together with topographical maps and wind models could be added to existing landscape-scale wildfire spread models to improve their predictive capabilities. The enhanced wildfire spread models would provide land managers and government agencies with better tools to prescribe preventive measures and fuels treatments before a fire, and allocate suppression resources and issue evacuation orders during a fire. Here an attempt is made to summarize the research issues of the wildfire spotting and initial growth problem by describing the distinct individual processes involved in the problem and by discussing their know-how status. Emphasis is given to those areas that the author is more familiar with, due to his work on the subject.

Bio: Dr. *Carlos Fernandez-Pello is a Distinguished Professor of the Graduate School in Mechanical Engineering at the University of California, Berkeley, USA. He received degrees of Doctor Aeronautical Engineer from the University of Madrid, Spain, and a Ph.D. in Engineering Sciences from the University of California, San Diego. He was a Postdoctoral Fellow at Harvard University, and a Research Faculty at Princeton University. He joined the University of California, Berkeley, in 1980, where he teaches and conducts research in thermal sciences with emphasis in fire related combustion. He held the Maynard Chair Professorship in Mechanical Engineering and became an over-scale distinguished professor. He also was Associate Dean of the Graduate Division, where he supervised several units related to university wide graduate studies. He is a member of the Royal Academy of Engineering of Spain, a Fellow of the Combustion Institute and of the ASME International. He is an Honorary Dr. of Engineering from the Universidad Nacional San Marcos, Peru. He has been awarded numerous awards including, the "2022 Microgravity and Space Processes Award" from the AIAA, the "Howard Emmons Award" at the 12th International Symposium of the IAFSS, the "Philip Thomas Medal of Excellence" at the 6th IAFSS symposium, the "International Prize" and the "Journal Award" from the Combustion Society of Japan, the "Pi Tau Sigma Award" for excellence in teaching" at UCB. He has been an Invited Visiting Professor at universities and research laboratories in Australia, Chile, China, France, Italy, Japan, and Spain. His recent research emphasizes material flammability in earth and spacecraft environments, and wildland fire development. Throughout his career he has studied ignition, smoldering and transition to flaming, micro-scale combustion, external effects on flames, among others. His research is, or has been funded by NASA, NSF, NIST, DARPA, DOE and ARO. He is co-author of the book "Fundamental of Combustion Processes" and of five book chapters. He has over 270 publications in peer reviewed journals and over 300 hundred non-reviewed papers.*