1. Record Nr. UNINA9910795474003321

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Titolo	Oil droplet impact dynamics in aero-engine bearing chambers : correlations derived from direct numerical simulations / / Davide Peduto
Pubbl/distr/stampa	Berlin : Logos Verlag, 2015 : , : Logos Verlag, , 2015
ISBN	3-8325-9493-0
Descrizione fisica	1 online resource (181 pages)
Collana	Forschungsberichte aus dem Institut für Thermische Strömungsmaschinen
Disciplina	629.255
Soggetti	Lubricating oils
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Note generali	PublicationDate: 20150630

Sommario/riassunto

Long description: Bearing Chambers in Aero-Engines are located near the rolling-element type of bearings which support the shafts and accommodate the resulting thrust loads. One of the main task of the bearing chambers is, beside an efficient scavenging of the lubricating oil, the cooling of the hot compartments. A very complex two-phase air-oil flow takes usually place in these bearing chambers consisting of oil droplet-laden air flows and shear-driven liquid wall films. The interaction of the droplets with the wall films is significantly influencing the wall heat transfer and the cooling performance of these systems. For this reason, a detailed characterization and modelling of the mass and momentum exchange between droplets and wall films for the unique impingement parameter range in bearing chambers is inevitable. This scientific report investigates the oil droplet impact dynamics for typical impingement regimes relevant to aero-engine bearing chambers. The application of a Direct Numerical Simulation (DNS) technique based on the Volume-of-Fluid (VOF) method and coupled with a gradient-based adaptive mesh refinement (AMR) technique allowed to characterize the drop impact dynamics during various single micro- and millimeter drop impacts onto thin and thick films. With the help of a special numerical treatment, a self-perturbing mechanism is installed that leads to the correct resolution of the crown

disintegration process. The numerical methodology was thoroughly validated using the experimental results of millimeter sized drop impacts onto deep liquid pools. These results were developed with an enhanced back-illuminated high-speed imaging and Particle Tracking Velocimetry (PTV) technique. New insights into the cavity penetration, the crown's breakup dynamics and the secondary droplet characteristics following a single drop impact have been developed with the help of the isolated variation of different parameters of influence. Particularly the influence of the Froude number, the impingement angle, and the cavity-wall interaction delivered results to date not reported in scientific literature. Beside the advances in fundamental physics describing the drop impact dynamics with the help of the numerical and experimental results, a set of correlations could also be derived. From these correlations, a drop-film interaction model was formulated that is suitable for the parameter range found in bearing chambers.