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Microgravity Sciences onboard the International Space Station and Beyond (6)

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# INVESTIGATION OF MARANGONI CONVECTION IN INTERNATIONAL SPACE STATION

**Abstract**

Marangoni convection is a convective flow pattern in a liquid induced by a surface tension gradient. Surface tension, which is a physical property of the fluid, varies significantly with temperature and concentration, hence whenever a thermal or a concentration gradient is imposed, a surface tension gradient is present. The part of the fluid with the highest surface tension (lowest temperature) will pull another part of the fluid with a lower surface tension (highest temperature). The resulting flow is termed Marangoni convection. This type of convection is encountered mainly in manufacturing of semiconductors using the floating zone crystal growth method to preserve its purity. Hence understanding the nature of Marangoni convection is important. Unfortunately, Marangoni convection cannot be studied intensively on earth, where gravitational effects outweigh the surface tension effects, hence the Marangoni convection experiments are currently conducted in microgravity aboard the International Space Station with a silicone oil liquid bridge using a Fluid Physics Experiment Facility on JAXA's Kibou Module. The research work underway at the University of Toronto is geared towards understanding the effect of external vibrations called g-jitter on the liquid bridge in a Marangoni convection experiment under microgravity and normal gravity. In order to understand the frequency and amplitude of the liquid bridge vibration, video image data and acceleration data from the International Space Station (ISS) are being analyzed. The liquid bridge vibration frequency data obtained from the ISS experiments will be compared with an analytical model based on a spring-mass-damper analogy which predicts the natural frequency. In order to investigate the vibration amplitude of the liquid bridge, the MMA accelerometer data obtained from NASA will be used in a numerical simulation model to predict the liquid bridge vibration in a greater detail. The above analytical, numerical and experimental results would further our understanding of the g-jitter induced vibration of a liquid bridge under microgravity and the relationship between the Marangoni convection intensity and the liquid bridge vibration frequency and amplitude.