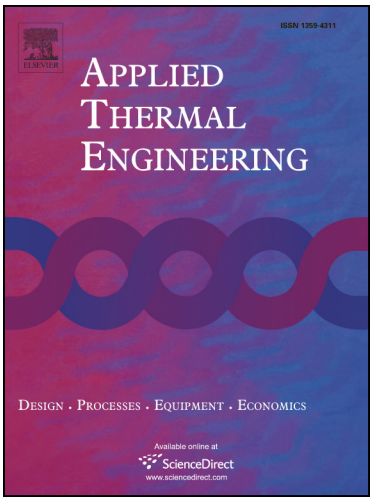

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Abstract

In this paper, numerical simulation is carried out to study the flow and heat transfer of pulsating flow in 30°, 45°, 60° and 90° ribbed channels (*AR*=2). Turbulence model validation has been conducted for steady flow only, indicating that SST *k*-ω model predicts heat transfer in ribbed channels fairly well. The secondary flows and *Nu* distributions in ribbed channels are investigated for both steady flow and pulsating flow. Numerical results indicate that pulsating flow affects longitudinal secondary flow and transverse secondary flow in quite different ways. The time-averaged *Nu* on ribbed surface of pulsating flow is significantly higher than that of steady flow in most cases, especially for 90° rib case. There is an optimal frequency for each channel to achieve the best heat transfer. In addition, increasing pulsation amplitude and *Re* will noticeably promote heat transfer for all the cases. Though pulsating flow introduces large pressure loss, considerable improvement of thermal performance will be achieved at high *Re*. The 90° ribbed channel shows distinguished characteristics with pulsating flow, which gains an increment of 39% in overall thermal performance parameter at *Re*=40000, *f*=150Hz and *A*=0.2.

Keywords: Ribbed channel, Gas turbine, Pulsating flow, Heat transfer, CFD

Introduction

The thermodynamic cycle of gas turbine bases on classic Brayton cycle, which means higher efficiency will be achieved by improving turbine inlet temperature(TIT). To date, the TIT of advanced gas turbine design is close to 2000K, which is far beyond the allowable temperature of gas turbine blades. For such harsh operating conditions, gas turbine blades benefit much from complicated cooling system including internal ribbed channel cooling, as shown in Fig.1. Air coolant extracted from compressor will be injected into the channels to remove the heat load from blades.

The flow and heat transfer characteristics in ribbed channels mainly depend on flow parameters and geometric configurations, such as rib cross section, rib angle, rib arrangement, pitch-to-height ratio, aspect ratio and inlet