Engler-Bunte-InstitutTeilinstitut Verbrennungstechnik (EBI-vbt)

Tutoren/innen gesucht für Numerik-Praktikum

Wir suchen noch studentische Betreuer für das Praktikum Numerik im Ingenieurwesen.
mehr ...

Chemischer
Gleichgewichtsrechner

Probieren Sie auf dieser Seite unser Programm für die Berechnung des thermodynamischen Gleichgewichtes einer Gasmischung
mehr ...

Kontakt

Engler-Bunte-Ring 7
76131 Karlsruhe

Gebäude 40.13.I

Tel: +49(0)721 608-42571
Fax: +49(0)721 608-47770

E-Mail: Sekretariat
Link zur Seite:

Kooperationspartner:

Bachelor- und Masterarbeiten

Aktuelle Angebote für das Anfertigen von Bachelor- und Masterarbeiten finden sie auf der folgenden Seite.
mehr ...

"Pressure based atomization"

Positioning of jet along the axis of a swirl jet is one of very commonly used application in the gas turbine combustors. Such combination leads to very different flame shapes depending upon the interaction between two concentric jets. Gas turbine combustion engineers thrive to obtain very high flame stability at low power conditions (idle); whereas low emissions are desired at high power conditions (Take off or Cruise). High flame stability can be obtained if the fuel coming out axial jet has least interaction with concentric jet flow. Such kind of flame are known as Jet type flames and denoted as Type 1 flame. On the other hand if fuel-air mixture coming out the central jet has good mixing with main flow, then recirculating type of flames are obtained. Such flames are denoted as Type 2 flame and have characteristics of low emissions due to very good mixing. In this work the occurrences of these very two different flame types (Type 1 and Type 2) has been demonstrated using both computational analysis and as well experimental techniques. Using a commercial solver Fluent, isothermal turbulent flow simulations are performed to understand the mixing process. The measurement techniques Laser Doppler Anemometry and OH* Chemiluminescence have been used to measure flow field and characterize the flame, respectively. Measurements performed at industry relevant conditions show that by having an equivalence ratio and inner axial jet momentum combination, desired combustion characteristics in the combustor can be obtained.

Burner used in this work is depicted in Figure 1. Multi-swirled nozzle has two coannular jets, a pilot jet in the centre and a main swirler placed coaxial to the central jet. Gaseous fuel is allowed to mix with pilot air flow as shown.

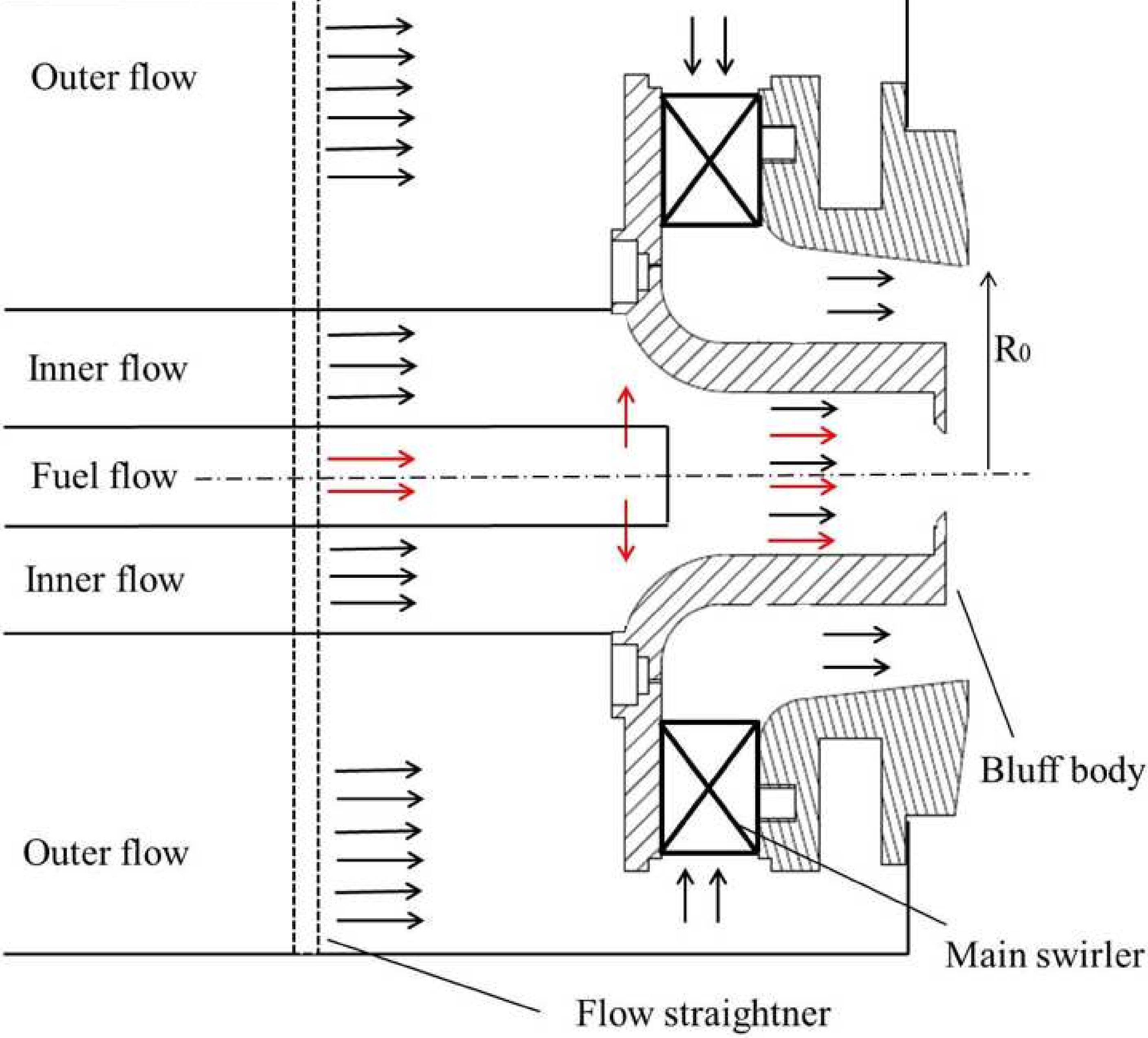

Fig. 1: Burner used in present work

By changing the mass flow through the central jet and by keeping main flow constant, the flow field in the combustor can be obtained as shown in Figure 2. Top half of the figure shows streamlines resulting from Type 1 flame flow field, where postive axial velocities exist along the axis, which means axial jet is able to penetrate the recirculation zone. Bottom half streamlines show the flow field resulting from non-penetration of axial jet into the recirculation bubble, and recirculating flow exits along the axis (Type 2 flow field).

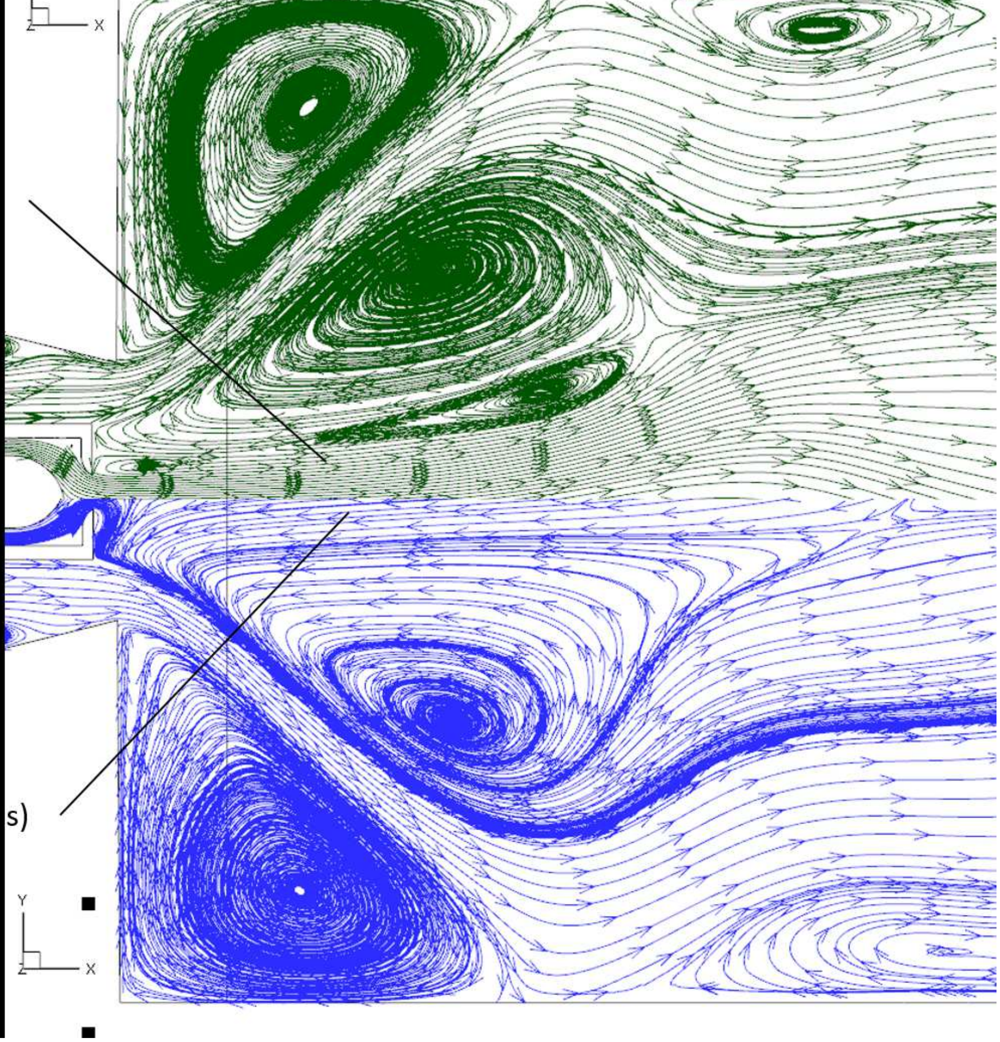

Fig. 2: Streamlines depicting different types of flow field at midplane

Figure 3 shows the iso-surfaces of zero axial velocities (i.e. surface of recirculation zone) coloured with fuel distribution. It is clearly noticeable that fuel distributes evenly in Type 2, overall lower values of mole fraction is observed at recirculation bubble surface as compared to the case in Type 1 flow field.

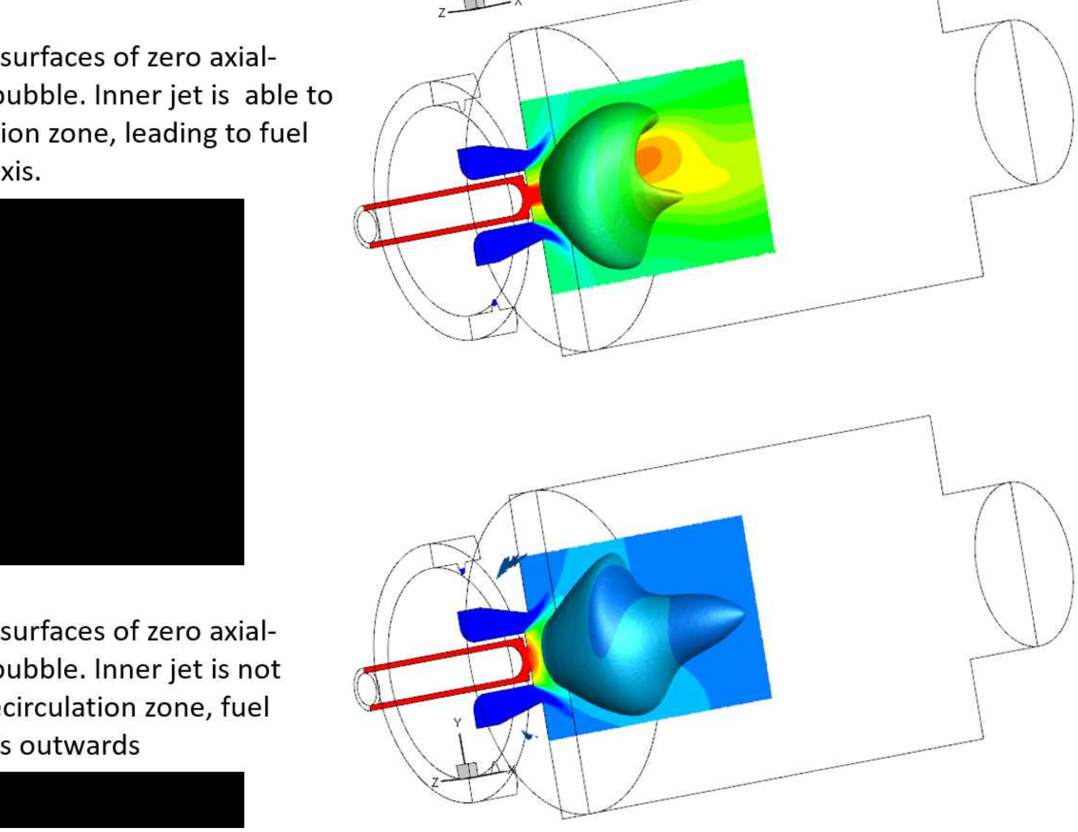

Fig. 3: Iso-surfaces of zero axial velocity coloured with fuel distribution in terms of methane gas mole fraction.

As seen above with change in recirculation characteristics, the fuel distribution also gets affected which further leads to differences in flame shape and its positioning in the combustor as shown in Figure 4 and Figure 5. The flame shape changes from a jet flow to a recirculating jet flow in the combustor by changing the momentum of pilot jet. At large values momentum of pilot jet, Type 1 flame is observed due to penetration of jet into the recirculation zone.

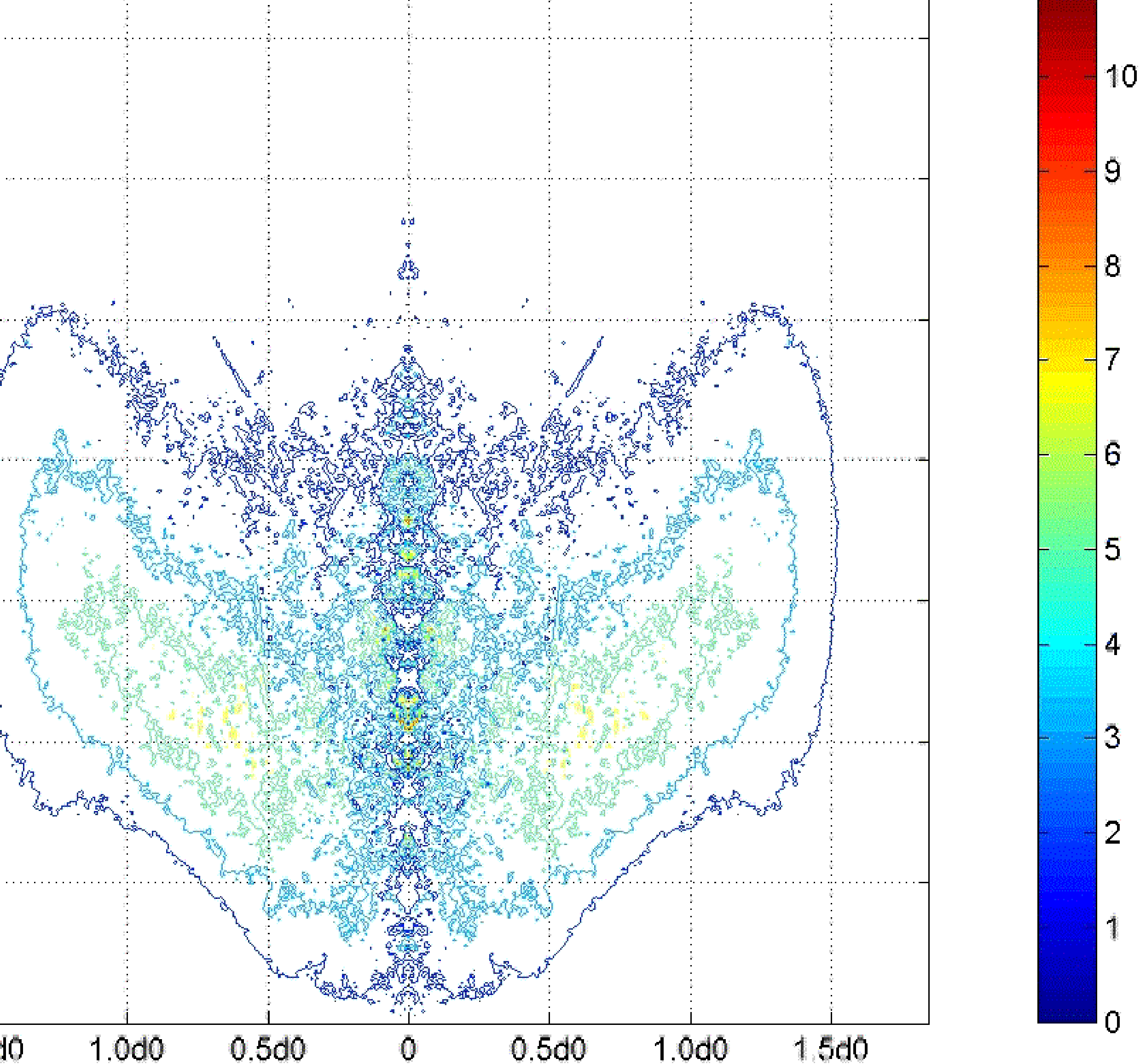

Fig. 4: OH chemiluminescence images of flame shape with variation in the momentum of central jet. (scale is normalized light intensity)

Fig. 5: Photographs of flame with variation in the momentum of central jet.

It is demonstrated in this work that in order to fully characterize occurance of such type of flames, one has to take both air flow rate (momentum of pilot jet) as well as the stiochiometric ratio of the pilot mixture into account. As very high fuel rich mixture along the axis can lead to fuel-air distribution beyond flammability limits, flame stabilizes itself at higher radial locations as shown in Figure 6.

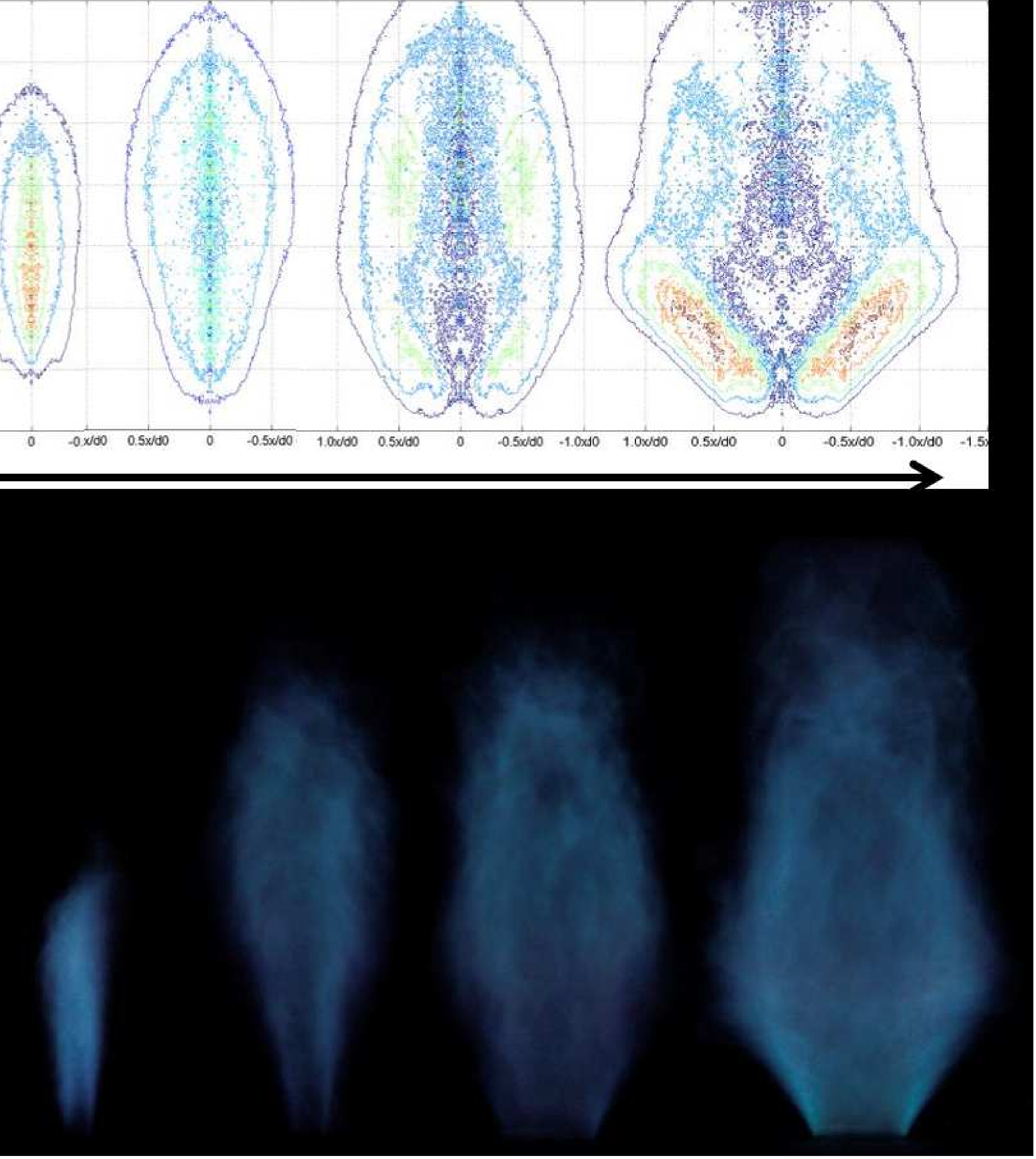

Fig. 6: Effect of fuel flow rate on flame shape

Effect of introducing swirl to the pilot flow on the flow field is also studied in this work. With some modifications the burner has been successfully tested with liquid fuel as well. Details regarding flames of Type 1 with liquid fuel can be found in Literature.

[IMAGE]
Update Page

- Heruntergeladen am Tue Sep 29 10:57:37 CEST 2020 ; eine aktuelle Version finden Sie unter: