

# Presentation of Dissertation

## (Effect of surface texturing on friction under starved lubrication conditions)

Fadi ALI

*Tato prezentace je spolufinancována  
Evropským sociálním fondem  
a státním rozpočtem České republiky.*



MINISTERSTVO ŠKOLSTVÍ,  
MLÁDEŽE A TĚLOVÝCHOVY



OP Vzdělávání  
pro konkurenceschopnost



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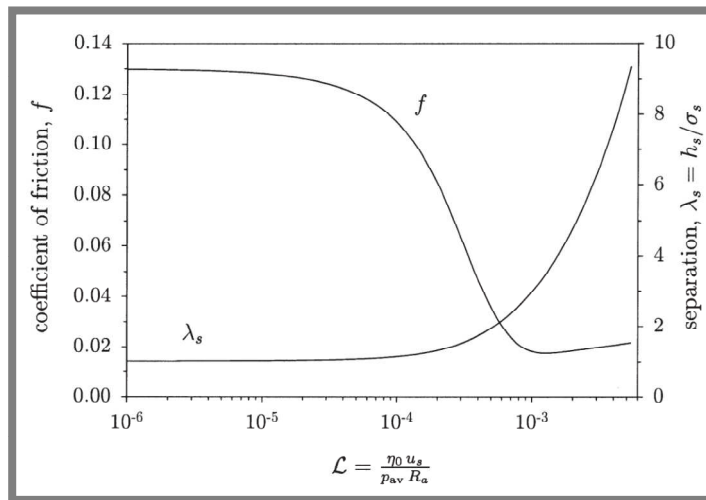
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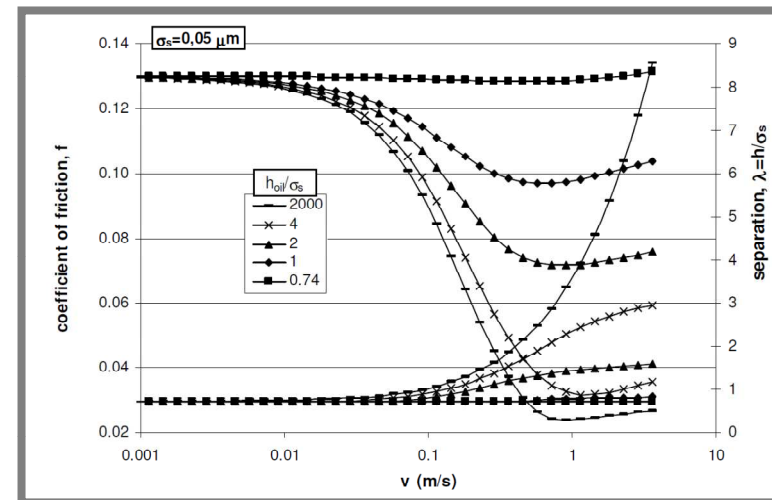
## INTRODUCTION

Gelinck et al. 2000



Friction coefficient ( $f$ ) and separation ( $\lambda_s$ ) as a function of Hersey number ( $\eta_0 u_s/p_{av}$ )

Faraon et al. 2007



Effect of starvation on the friction coefficient and separation

## TITLE

- Effect of surface texturing on friction under starved lubrication conditions.

**SUPERVISOR:** prof. Ing. Martin Hartl, Ph.D.

## AIM OF DISSERTATION

- Studying experimentally the effect of artificial micro-dents on reducing the coefficient of friction in sliding motion between non-conformal surfaces under starved lubrication .
- Comparing with results under fully flooded conditions.

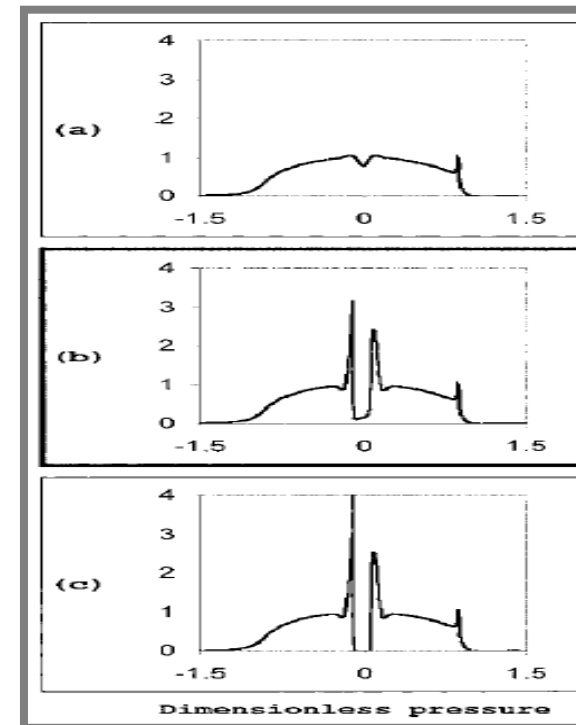
## LITERATURE REVIEW

- Effect of micro-dimples size on the pressure distribution and film thickness profile in EHL contacts.

## RESULTS

- No effect for small size of micro-dents.
- Positive effect for intermediate size (no cavitation)
- Negative effect for large size due to the cavitation.

Nélias et al. 2000



Effect of micro-dimples size on the pressure distribution and film thickness profile

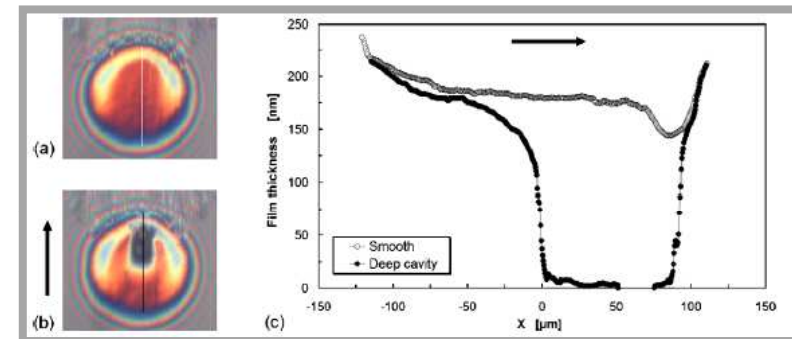
## LITERATURE REVIEW

- Effect of micro-dimples depth

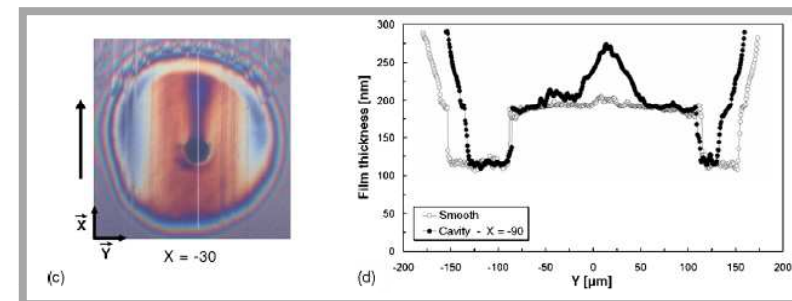
## RESULTS

- Shallow micro-cavities enhance film thickness.
- Deep micro-cavities cause a reduction in film thickness.

Mourier et al. 2008



Deep micro-cavities



Shallow micro-cavities

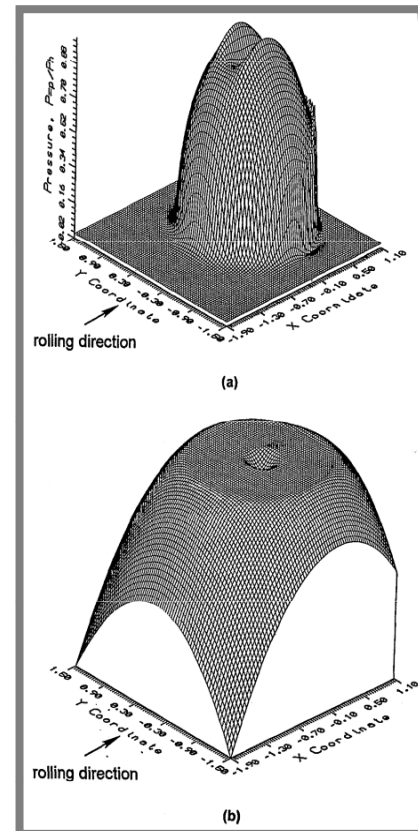
Ai et al. 1994

## LITERATURE REVIEW

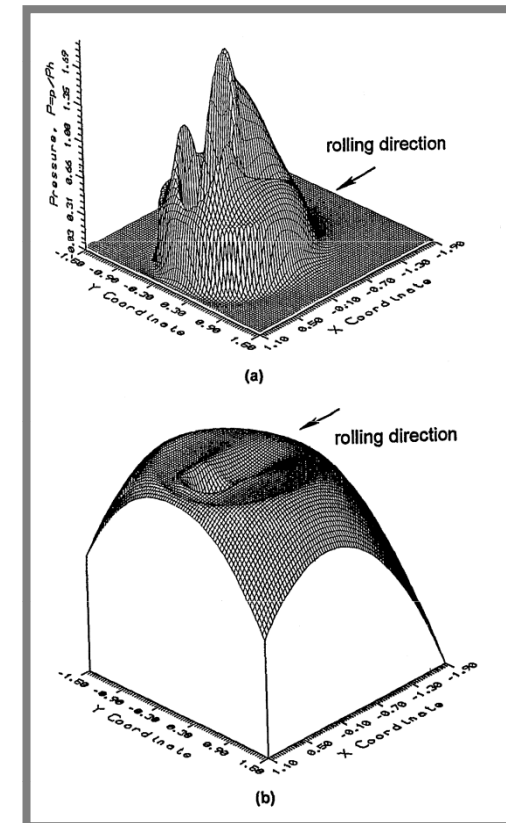
- Effect of slide-to-roll ratio (SR).

## RESULTS

- Limited effect under pure rolling conditions.
- Positive effect when the sliding is introduced.



SR=0



SR=2

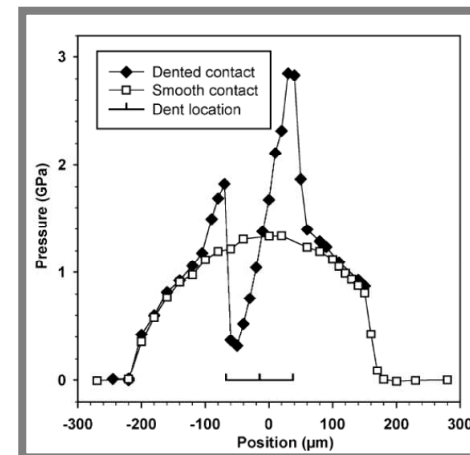
## LITERATURE REVIEW

- Effect of micro-dents on rolling contact fatigue (RCF)

## RESULTS

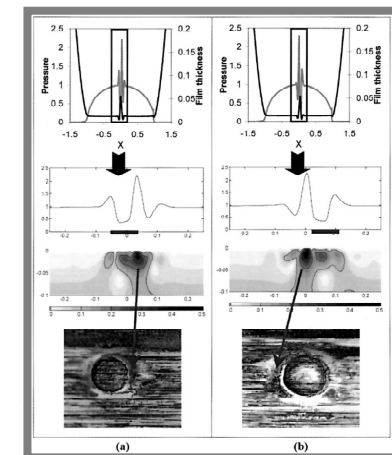
- Low stress concentration was found under pure rolling. Slide-to-roll ratio increases the stress level .
- Location of concentrated pressure depends on the direction of sliding.

Coulon et al. 2004



Pressure profiles for smooth and dented contact

Nélias et al. 2000



stress field in the vicinity of micro-dent

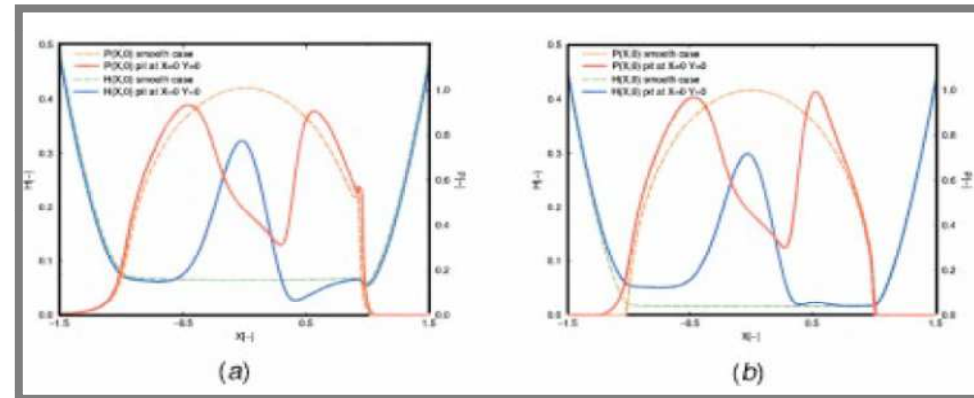
### LITERATURE REVIEW

- Effect of micro-dimpling under starved conditions.

### RESULTS

- The beneficial increase of film thickness is lost if the contact becomes fully flooded.

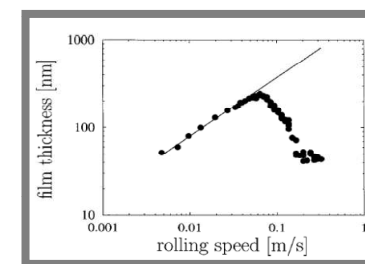
Dumont et al. 2002



a) Fully flooded contact

b) Starved contact

Damiens et al. 2004



Film thickness under starved lubrication

Tato prezentace byla vytvořena jako součást projektu "Komplexní systém pro získávání, vzdělávání a trvalé zapojování talentů do výzkumných a vývojových center AV ČR a FSI VUT v Brně", reg. č. CZ.1.07/2.3.00/09.0228



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## BIBLIOGRAPHY

### Coefficient of friction under starved conditions :

- FARAON, I.C. AND SCHIPPER, D.J. 2006 , 2007
- Querlioz et al. 2007

### Surface textures of conformal surfaces:

- Etsion et al. 1999, 2002,2009.
- NANBU et al. 2008

### Effect of surface textures on pressure distribution and film thickness profile in EHL contacts:

- COULON, S. et al . 2004
- MOURIER, L. et al. 2006, 2008,2010
- WEDEVEN, L.D. et al.1979
- Cusano, C. et al. 1981
- Yang ,P. et al . 2004
- Kaneta, M. et al. 1997
- Al, X.L. et al 1994 , 1996
- Lubrecht A.A. 1997
- KRUPKA, I. et al. 2007, 2008,2010

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### Starved lubrication:

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- OLARU, D.N. et al. 1993
- CHEVALIER, F. et al. 1998
- WEDEVEN, L.D. et al 1971
- GHOSH, M.K. et al. 1987

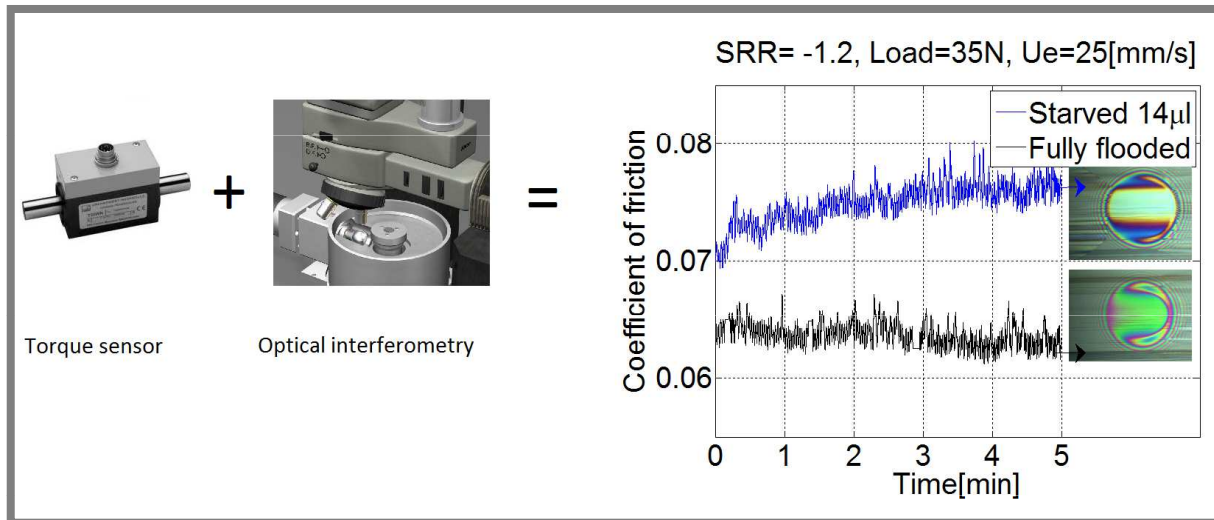
### Surface feature effect under starved lubrication :

- DUMONT, M. et al. 2002

### Effect of Surface texture on contact fatigue:

- CHENG, W. et al. 1994
- Zhai X, et al. 1997
- Ai X. et al. 1996, 2000, 2001
- NELIAS, D. et al 2000

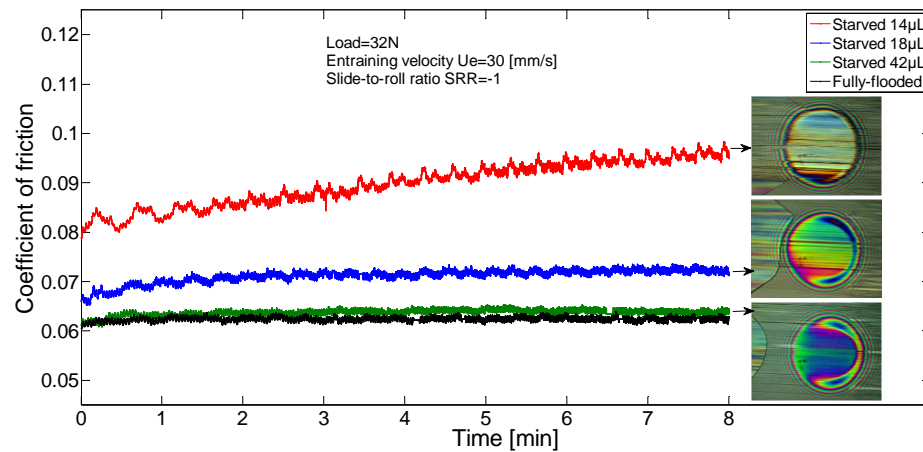
## METHODOLOGY



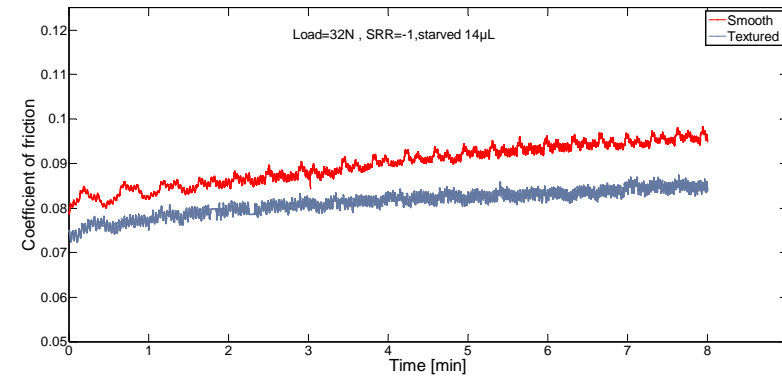
MTM(Mini Traction Machine)

Torque sensor in combination with optical interferometry

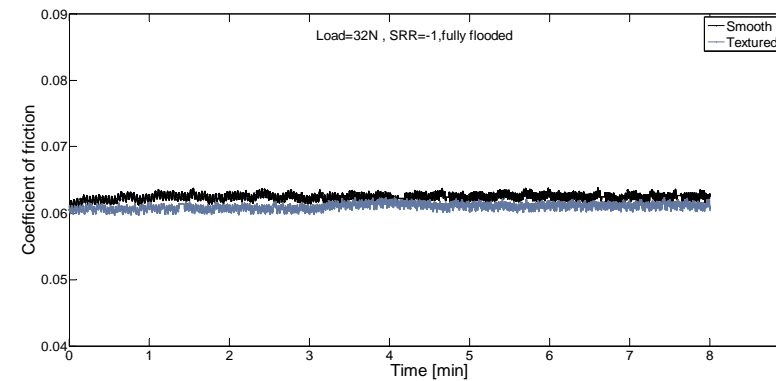
### PRELIMINARY RESULTS



Effect of Starvation on the coefficient of friction



coefficient of friction of smooth and dented surfaces under starved lubrication



coefficient of friction of smooth and dented surfaces under fully flooded lubrication

Tato prezentace byla vytvořena jako součást projektu  
"Komplexní systém pro získávání, vzdělávání a trvalé zapojování  
talentů do výzkumných a vývojových center AV ČR a FSI VUT v Brně",  
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## CONCLUSIONS

- The value of friction coefficient under starved lubrication is strongly influenced by the position of air-oil meniscus from the center of Hertzian contact.
- The effect of shallow micro-dents on the friction coefficient is negligible under fully flooded conditions.
- Shallow micro-dents can help in reducing the friction coefficient under starved lubrication.

# THANK YOU

*Tato prezentace byla vytvořena jako součást projektu  
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