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## References

1. S. Abhyankar, *Lectures on expansion techniques in algebraic geometry*, Tata Inst. Fund. Res. Lectures on Math. and Phys., vol. 57, Tata Inst. Fund. Res., Bombay, 1977, (Notes by B. Singh).
2. S. Abhyankar, P. Eakin, and W. Heinzer, *On the uniqueness of the coefficient ring in a polynomial ring*, J. Algebra **23** (1972), 310–342.
3. S. Abhyankar and T.T. Moh, *Embeddings of the line in the plane*, J. Reine Angew. Math. **276** (1975), 148–166.
4. A. A'Campo-Neuen, *Note on a counterexample to Hilbert's fourteenth problem given by P. Roberts*, Indag. Math., N.S. **5** (1994), 253–257.
5. I. V. Arzhantsev, *Affine embeddings of homogeneous spaces*, preprint 2005, arXiv:math.AG/0503563 v1.
6. T. Asanuma, *Non-linearizable algebraic actions on  $\mathbb{A}^n$* , J. Algebra **166** (1994), 72–79.
7. ———, *Non-linearizable algebraic  $k^*$ -actions on affine spaces*, Invent. Math. **138** (1999), 281–306.
8. T. Bandman and L. Makar-Limanov, *Affine surfaces with  $AK(S) = \mathbb{C}$* , Michigan Math. J. **49** (2001), 567–582.
9. ———, *Non-stability of  $AK$ -invariant*, Michigan Math. J. **53** (2005), 263–281.
10. V. Baranovsky, *The variety of pairs of commuting nilpotent matrices is irreducible*, Transform. Groups **6** (2001), 3–8.
11. R. Basili, *On the irreducibility of commuting varieties of nilpotent matrices*, J. Algebra **268** (2003), 58–80.
12. H. Bass, *A non-triangular action of  $\mathbb{G}_a$  on  $\mathbb{A}^3$* , J. Pure Appl. Algebra **33** (1984), 1–5.
13. ———, *Algebraic group actions on affine spaces*, Contemp. Math. **43** (1985), 1–23.
14. J. Berson, *Derivations on polynomial rings over a domain*, Master's thesis, Univ. Nijmegen, The Netherlands, 1999.
15. J. Berson and A. van den Essen, *An algorithm to find a coordinate's mate*, J. Symbolic Comput. **36** (2003), 835–843.
16. J. Berson, A. van den Essen, and S. Maubach, *Derivations having divergence zero on  $R[x, y]$* , Israel J. Math. **124** (2001), 115–124.
17. J. Bertin, *Pinceaux de droites et automorphismes des surfaces affines*, J. Reine Angew. Math. **341** (1983), 32–53.

18. S.M. Bhatwadekar and A.K. Dutta, *Kernel of Locally Nilpotent R-Derivations of  $R[X, Y]$* , Trans. Amer. Math. Soc. **349** (1997), 3303–3319.
19. S.M. Bhatwadekar and A. Roy, *Some results on embedding of a line in 3-space*, J. Algebra **142** (1991), 101–109.
20. A. Białynicki-Birula, *Remarks on the action of an algebraic torus on  $k^n$* , Bull. Acad. Pol. Sci. **14** (1966), 177–181.
21. ———, *Remarks on the action of an algebraic torus on  $k^n$ , II*, Bull. Acad. Pol. Sci. **15** (1967), 123–125.
22. ———, *On fixed point schemes of actions of multiplicative and additive groups*, Topology **12** (1973), 99–103.
23. M. de Bondt and A. van den Essen, *Nilpotent symmetric Jacobian matrices and the Jacobian Conjecture*, J. Pure Appl. Algebra **193** (2004), 61–70.
24. ———, *The Jacobian Conjecture: linear triangularization for homogeneous polynomial maps in dimension three*, J. Algebra **294** (2005), 294–306.
25. ———, *A reduction of the Jacobian Conjecture to the symmetric case*, Proc. Amer. Math. Soc. **133** (2005), 2201–2205.
26. P. Bonnet, *A proof of Miyanishi’s result for homogeneous locally nilpotent derivations on  $\mathbb{C}[x_1, x_2, x_3]$* , unpublished note, 2004, 5 pages.
27. ———, *Surjectivity of quotient maps for algebraic  $(\mathbb{C}, +)$ -actions*, Transform. Groups **7** (2002), 3–14.
28. A. Borel, *Linear Algebraic Groups*, Graduate Texts in Mathematics, vol. 126, Springer-Verlag, 1991, Berlin, Heidelberg, New York.
29. ———, *Essays in the History of Lie Groups and Algebraic Groups*, History of Mathematics, vol. 21, Amer. Math. Soc. and London Math. Soc., 2001, Providence, London.
30. N. Bourbaki, *Lie groups and lie algebras*, Elements of Math. Ch.1-3, Springer-Verlag, 1989, Berlin, New York.
31. Collected by G. Freudenburg and P. Russell, *Open problems in affine algebraic geometry*, Contemp. Math. **369** (2005), 1–30.
32. A. Castravet and J. Tevelev, *Hilbert’s 14-th Problem and Cox rings*, preprint, 2005, avail. at arXiv:math.AG/0505337v1.
33. A. Cerezo, *Table des invariants algébriques et rationnels d’une matrice nilpotente de petite dimension*, Tech. Report 146, Université de Nice Prepub. Math., France, 1987.
34. D. Cerveau, *Dérivations surjectives de l’anneau  $\mathbb{C}[x, y]$* , J. Algebra **195** (1997), 320–335.
35. A. Choudary and A. Dimca, *Complex hypersurfaces diffeomorphic to affine spaces*, Kodai Math. J. **12** (1994), 171–178.
36. A.M. Cohen and J. Draisma, *From Lie algebras of vector fields to algebraic actions*, Transform. Groups **8** (2003), 51–68.
37. P. M. Cohn, *Algebra, Vol. 1 (Second Ed.)*, John Wiley and Sons, 1982, Chichester, New York.
38. B. Coomes and V. Zurkowski, *Linearization of polynomial flows and spectra of derivations*, J. Dynamics Differential Equations **3** (1991), 29–66.
39. A. Crachiola, *On the AK-Invariant of Certain Domains*, Ph.D. thesis, Wayne State University, Detroit, Michigan, 2004.
40. ———, *The hypersurface  $x + x^2y + z^2 + t^3 = 0$  over a field of arbitrary characteristic*, Proc. Amer. Math. Soc. **134** (2006), 1289–1298.
41. A. Crachiola and L. Makar-Limanov, *An algebraic proof of a cancellation theorem for surfaces*, preprint 2005, 9 pages.

42. ———, *On the rigidity of small domains*, J. Algebra **284** (2005), 1–12.
43. A. Crachiola and S. Maubach, *The Derksen invariant vs. the Makar-Limanov invariant*, Proc. Amer. Math. Soc. **131** (2003), 3365–3369.
44. P. C. Craighero, *A result on  $m$ -flats in  $\mathbb{A}_k^n$* , Rend. Sem. Mat. Univ. Padova **75** (1986), 39–46.
45. ———, *A remark on Abhyankar’s space lines*, Rend. Sem. Mat. Univ. Padova **80** (1988), 87–93.
46. D. Daigle, *Classification of homogeneous locally nilpotent derivations of  $k[x, y, z]$* , preprint 2003.
47. ———, *Locally Nilpotent Derivations*, Lecture Notes for the 26th Autumn School of Algebraic Geometry, Łukęcin, Poland, September 2003. Avail. at <http://aix1.uottawa.ca/ddaigle/>.
48. ———, *A necessary and sufficient condition for triangulability of derivations of  $k[x, y, z]$* , J. Pure Appl. Algebra **113** (1996), 297–305.
49. ———, *On some properties of locally nilpotent derivations*, J. Pure Appl. Algebra **114** (1997), 221–230.
50. ———, *Homogeneous locally nilpotent derivations of  $k[x, y, z]$* , J. Pure Appl. Algebra **128** (1998), 109–132.
51. ———, *On kernels of homogeneous locally nilpotent derivations of  $k[x, y, z]$* , Osaka J. Math. **37** (2000), 689–699.
52. ———, *On locally nilpotent derivations of  $k[x_1, x_2, y]/(\phi(y) - x_1x_2)$* , J. Pure Appl. Algebra **181** (2003), 181–208.
53. ———, *Locally nilpotent derivations and Danielewski surfaces*, Osaka J. Math. **41** (2004), 37–80.
54. D. Daigle and G. Freudenburg, *Locally nilpotent derivations over a UFD and an application to rank two locally nilpotent derivations of  $k[X_1, \dots, X_n]$* , J. Algebra **204** (1998), 353–371.
55. ———, *A counterexample to Hilbert’s Fourteenth Problem in dimension five*, J. Algebra **221** (1999), 528–535.
56. ———, *A note on triangular derivations of  $k[X_1, X_2, X_3, X_4]$* , Proc. Amer. Math. Soc. **129** (2001), 657–662.
57. ———, *Triangular derivations of  $k[X_1, X_2, X_3, X_4]$* , J. Algebra **241** (2001), 328–339.
58. D. Daigle and S. Kaliman, *A note on locally nilpotent derivations and variables of  $k[x, y, z]$* , preprint 2004, 9 pages.
59. D. Daigle and P. Russell, *Affine rulings of normal rational surfaces*, Osaka J. Math. **38** (2001), 37–100.
60. ———, *On weighted projective planes and their affine rulings*, Osaka J. Math. **38** (2001), 101–150.
61. ———, *On  $\log \mathbb{Q}$ -homology planes and weighted projective planes*, Canad. J. Math. **56** (2004), 1145–1189.
62. W. Danielewski, *On the cancellation problem and automorphism groups of affine algebraic varieties*, Preprint, Warsaw, 1989.
63. V. I. Danilov and M. H. Gizatullin, *Automorphisms of affine surfaces*, Izv. Akad. Nauk SSSR Ser. Mat. **39** (1975), 523–565.
64. M. de Bondt, *Homogeneous quasi-translations and an article of P. Gordan and M. Nöther*, preprint, 2005, 16 pages.
65. ———, *Quasi-translations and counterexamples to the Homogeneous Dependence Problem*, preprint, 2004, 10 pages.

66. H. Derksen, *The kernel of a derivation*, J. Pure Appl. Algebra **84** (1993), 13–16.
67. ———, *Quotients of algebraic group actions*, Automorphisms of affine spaces (Dordrecht) (A. van den Essen, ed.), Kluwer, 1995, pp. 191–200.
68. ———, *Constructive Invariant Theory and the Linearization Problem*, Ph.D. thesis, Univ. Basel, 1997.
69. H. Derksen, A. van den Essen, and P. van Rossum, *The cancellation problem in dimension four*, Tech. Report 0022, Dept. of Mathematics, Univ. Nijmegen, The Netherlands, 2000.
70. H. Derksen, O. Hadas, and L. Makar-Limanov, *Newton polytopes of invariants of additive group actions*, J. Pure Appl. Algebra **156** (2001), 187–197.
71. H. Derksen and G. Kemper, *Computational Invariant Theory*, Springer Verlag, Berlin, Heidelberg, New York, 2002.
72. H. Derksen and F. Kutzschebauch, *Nonlinearizable holomorphic group actions*, Math. Ann. **311** (1998), 41–53.
73. J. K. Deveney and D. R. Finston, *Rationally triangulable automorphisms*, J. Pure and Appl. Algebra **72** (1991), 1–4.
74. ———, *Fields of  $\mathbb{G}_a$  invariants are ruled*, Canad. Math. Bull. **37** (1994), 37–41.
75. ———,  *$\mathbb{G}_a$ -actions on  $\mathbb{C}^3$  and  $\mathbb{C}^7$* , Comm. Algebra **22** (1994), 6295–6302.
76. ———, *Algebraic aspects of additive group actions on complex affine space*, Automorphisms of affine spaces (Dordrecht) (A. van den Essen, ed.), Kluwer, 1995, pp. 179–190.
77. ———, *A proper  $\mathbb{G}_a$ -action on  $\mathbb{C}^5$  which is not locally trivial*, Proc. Amer. Math. Soc. **123** (1995), 651–655.
78. ———, *On locally trivially  $\mathbb{G}_a$ -actions*, Transform. Groups **2** (1997), 137–145.
79. ———, *Free  $\mathbb{G}_a$ -actions on  $\mathbb{C}^3$* , Proc. Amer. Math. Soc. **128** (1999), 131–138.
80. ———,  *$\mathbb{G}_a$ -invariants and slices*, Comm. Algebra **30** (2002), 1437–1447.
81. J. K. Deveney, D. R. Finston, and M. Gehrke,  *$\mathbb{G}_a$ -actions on  $\mathbb{C}^n$* , Comm. Algebra **12** (1994), 4977–4988.
82. W. Dicks, *Automorphisms of the polynomial ring in two variables*, Publ. Sec. Mat. Univ. Aut3noma Barcelona **27** (1983), 155–162.
83. J. Dieudonn3e and J. Carrell, *Invariant theory, old and new*, Adv. Math. **4** (1970), 1–80.
84. A. Dimca, *Hypersurfaces in  $\mathbb{C}^{2n}$  diffeomorphic to  $\mathbb{R}^{4n-2}$  ( $n \geq 2$ )*, Max-Plank Institute, preprint, 1990.
85. J. Dixmier, *Lectures on Binary Forms*, West Chester University of Pennsylvania (Notes by F. Grosshans), 1986.
86. ———, *Enveloping Algebras*, North-Holland Publishing, Amsterdam, New York, Oxford, 1977.
87. I. Dolgachev, *Lectures on Invariant Theory*, London Math. Soc. Lect. Notes Series, vol. 296, Cambridge University Press, Cambridge, UK, 2003.
88. J. Draisma, *Lie algebras of vector fields*, Ph.D. thesis, Technische Universiteit Eindhoven (The Netherlands), 2002.
89. V. Drensky and G. K. Genov, *Multiplicities of Schur functions with applications to invariant theory and PI-algebras*, C. R. Acad. Bulgare Sci. **57** (2004), 5–10.
90. V. Drensky and J.-T. Yu, *Exponential automorphisms of polynomial algebras*, Comm. Algebra **26** (1998), 2977–2985.
91. L.M. Druzkowski and J. Gurycz, *An elementary proof of the tameness of polynomial automorphisms of  $k^2$* , Univ. Iagel. Acta Math. **35** (1997), 251–260.
92. A. Dubouloz, *Completions of normal affine surfaces with a trivial Makar-Limanov invariant*, Michigan Math. J **52** (2004), 289–308.

93. S. Ebey, *The operation of the universal domain on the plane*, Proc. Amer. Math. Soc. **13** (1962), 722–725.
94. M. El Kahoui, *Constants of derivations in polynomial rings over unique factorization domains*, Proc. Amer. Math. Soc. **132** (2004), 2537–2541.
95. ———, *UFDs with commuting linearly independent locally nilpotent derivations*, J. Algebra **289** (2005), 446–452.
96. W. Engel, *Ganze Cremona-Transformationen von Primzahlgrad in der Ebene*, Math. Ann. **136** (1958), 319–325.
97. A. van den Essen, *Locally finite and locally nilpotent derivations with applications to polynomial flows and morphisms*, Proc. Amer. Math. Soc. **116** (1992), 861–871.
98. ———, *An algorithm to compute the invariant ring of a  $\mathbb{G}_a$ -action on an affine variety*, J. Symbolic Comp. **16** (1993), 551–555.
99. ———, *Locally finite and locally nilpotent derivations with applications to polynomial flows, morphisms, and  $\mathbb{G}_a$ -actions, II*, Proc. Amer. Math. Soc. **121** (1994), 667–678.
100. ———, *Polynomial Automorphisms and the Jacobian Conjecture*, Birkhauser, Boston, 2000.
101. ———, *A simple solution of Hilbert’s fourteenth problem*, Colloq. Math. **105** (2006), 167–170.
102. A. van den Essen and T. Janssen, *Kernels of elementary derivations*, Tech. Report 9548, Dept. of Mathematics, Univ. Nijmegen, The Netherlands, 1995.
103. A. van den Essen and P. van Rossum, *Triangular derivations related to problems on affine  $n$ -space*, Proc. Amer. Math. Soc. **130** (2001), 1311–1322.
104. A. van den Essen and S. Washburn, *The Jacobian Conjecture for symmetric Jacobian matrices*, J. Pure Appl. Algebra **189** (2004), 123–133.
105. A. Fauntleroy, *Linear  $\mathbb{G}_a$ -actions on affine spaces and associated rings of invariants*, J. Pure Appl. Algebra **9** (1977), 195–206.
106. ———, *On Weitzenböck’s theorem in positive characteristic*, Proc. Amer. Math. Soc. **64** (1977), 209–213.
107. ———, *Algebraic and algebro-geometric interpretations of Weitzenböck’s problem*, J. Algebra **62** (1980), 21–38.
108. A. Fauntleroy and A. Magid, *Proper  $\mathbb{G}_a$ -actions*, Duke J. Math. **43** (1976), 723–729.
109. M. Ferrero, Y. Lequain, and A. Nowicki, *A note on locally nilpotent derivations*, J. Pure Appl. Algebra **79** (1992), 45–50.
110. K.-H. Fieseler, *On complex affine surfaces with  $\mathbb{C}^+$ -actions*, Comment. Math. Helvetici **69** (1994), 5–27.
111. D. Finston and S. Maubach, *The automorphism group of certain factorial three-folds and a cancellation problem*, preprint, 2006.
112. J. Fogarty, *Invariant Theory*, Benjamin, New York, 1969.
113. G. Freudenburg, *A linear counterexample to the Fourteenth Problem of Hilbert in dimension eleven*, Proc. Amer. Math. Soc. (to appear).
114. ———, *The Vénéreau polynomials relative to  $\mathbb{C}^*$ -fibrations and stable coordinates*, to appear in “Affine Algebraic Geometry”, Proceedings of the 2004 Conference to honor the retirement of M. Miyanishi.
115. ———, *One-parameter subgroups and the triangular subgroup of the affine Cremona group*, Automorphisms of Affine Spaces (Dordrecht) (A. van den Essen, ed.), Kluwer, 1995, pp. 201–213.

116. ———, *Triangulability criteria for additive group actions on affine space*, J. Pure and Appl. Algebra **105** (1995), 267–275.
117. ———, *A note on the kernel of a locally nilpotent derivation*, Proc. Amer. Math. Soc. **124** (1996), 27–29.
118. ———, *Local slice constructions in  $K[X, Y, Z]$* , Osaka J. Math. **34** (1997), 757–767.
119. ———, *Actions of  $\mathbb{G}_a$  on  $\mathbb{A}^3$  defined by homogeneous derivations*, J. Pure Appl. Algebra **126** (1998), 169–181.
120. ———, *A counterexample to Hilbert's Fourteenth Problem in dimension six*, Transform. Groups **5** (2000), 61–71.
121. G. Freudenburg and L. Moser-Jauslin, *Embeddings of Danielewski surfaces*, Math. Z. **245** (2003), 823–834.
122. ———, *Real and rational forms of certain  $O_2(\mathbb{C})$ -actions, and a solution to the Weak Complexification Problem*, Transform. Groups **9** (2004), 257–272.
123. A. Fujiki, *The fixed point set of  $\mathbb{C}$  actions on a compact complex space*, Osaka J. Math. **32** (1995), 1013–1022.
124. T. Fujita, *On Zariski problem*, Proc. Japan Acad. **55A** (1979), 106–110.
125. P. Gabriel and Y. Nouazé, *Idéaux premiers de l'algèbre enveloppante d'une algèbre de Lie nilpotente*, J. Algebra **6** (1967), 77–99.
126. M. H. Gizatullin, *Invariants of incomplete algebraic surfaces that can be obtained by means of completions*, Izv. Akad. Nauk SSSR Ser. Mat. **35** (1971), 485–497.
127. ———, *Quasihomogeneous affine surfaces*, Izv. Akad. Nauk SSSR Ser. Mat. **35** (1971), 1047–1071.
128. P. Gordan and M. Nöther, *Über die algebraische Formen, deren Hesse'sche Determinante identisch verschwindet*, Math. Ann. **10** (1876), 547–568.
129. G.-M. Greuel and G. Pfister, *Geometric quotients of unipotent group actions*, Proc. London Math. Soc. **67** (1993), 75–105.
130. F. Grosshans, *The invariants of unipotent radicals of parabolic subgroups*, Invent. Math. **73** (1983), 1–9.
131. F. D. Grosshans, *Algebraic Homogeneous Spaces and Invariant Theory*, Lect. Notes in Math., vol. 1673, Springer Verlag, 1997.
132. R. Gurjar, *A topological proof of a cancellation theorem for  $\mathbb{C}^2$* , Math. Z. **240** (2002), 83–94.
133. R. Gurjar and M. Miyanishi, *Automorphisms of affine surfaces with  $\mathbb{A}^1$ -fibrations*, Michigan Math. J. **53** (2005), 33–55.
134. R. V. Gurjar and M. Miyanishi, *On the Makar-Limanov invariant and fundamental group at infinity*, preprint 2002.
135. A. Gutwirth, *The action of an algebraic torus on an affine plane*, Trans. Amer. Math. Soc. **105** (1962), 407–414.
136. O. Hadas, *On the vertices of Newton polytopes associated with an automorphism of the ring of polynomials*, J. Pure Appl. Algebra **76** (1991), 81–86.
137. O. Hadas and L. Makar-Limanov, *Newton polytopes of constants of locally nilpotent derivations*, Comm. Algebra **28** (2000), 3667–3678.
138. D. Hadziev, *Some problems in the theory of vector invariants*, Soviet Math. Dokl. **7** (1966), 1608–1610.
139. J. Harris, *Algebraic Geometry: A First Course*, GTM, vol. 133, Springer-Verlag, 1992.
140. R. Hartshorne, *Algebraic Geometry*, GTM, vol. 52, Springer-Verlag, 1977.

141. H. Hasse and F. K. Schmidt, *Noch eine Begründung der Theorie der höheren Differentialquotienten in einem algebraischen Functionenkörper einer Unbestimmten*, J. Reine Angew. Math. **177** (1937), 215–237.
142. D. Hilbert, *Mathematische Probleme*, Archiv der Math. und Physik **1** (1901), 44–63, 213–237.
143. ———, *Mathematical Problems*, Bull. Amer. Math. Soc. **8** (1902), 437–479.
144. G. Hochschild and G. D. Mostow, *Unipotent groups in invariant theory*, Proc. Nat. Acad. Sci. USA **70** (1973), 646–648.
145. D. Holtackers, *On kernels of homogeneous derivations*, Master's thesis, Univ. Nijmegen, The Netherlands, 2003.
146. G. Horrocks, *Fixed point schemes of additive group actions*, Topology **8** (1969), 233–242.
147. J. E. Humphreys, *Linear Algebraic Groups*, Springer-Verlag (Berlin, Heidelberg, New York), 1981.
148. J. E. Humphreys, *Hilbert's Fourteenth Problem*, Amer. Math. Monthly **70** (1978), 341–353.
149. T. Igarashi, *Finite subgroups of the automorphism group of the affine plane*, Master's thesis, Osaka University, 1977.
150. S. Iitaka, *Algebraic geometry: An introduction to birational geometry of algebraic varieties*, Graduate Texts Math., vol. 76, Springer-Verlag (Berlin, Heidelberg, New York), 1982.
151. N. Ivanenko, *Some classes of linearizable polynomial maps*, J. Pure Appl. Algebra **126** (1998), 223–232.
152. Z. Jelonek, *The extension of regular and rational embeddings*, Math. Ann. **277** (1987), 113–120.
153. K. Jorgenson, *A note on a class of rings found as  $\mathbb{G}_a$ -invariants for locally trivial actions on normal affine varieties*, Rocky Mountain J. Math. **34** (2004), 1343–1352.
154. H. W. E. Jung, *Über ganze birationale Transformationen der Ebene*, J. Reine Angew. Math. **184** (1942), 161–174.
155. S. Kaliman, *Actions of  $\mathbb{C}^*$  and  $\mathbb{C}_+$  on affine algebraic varieties*, preliminary monograph 2006.
156. ———, *Extensions of isomorphisms between affine algebraic subvarieties of  $k^n$  to automorphisms of  $k^n$* , Proc. Amer. Math. Soc. **113** (1991), 325–334.
157. ———, *Isotopic embeddings of affine algebraic varieties into  $\mathbb{C}^n$* , Contemp. Math. **137** (1992), 291–295.
158. ———, *Smooth contractible hypersurfaces in  $\mathbb{C}^n$  and exotic algebraic structures on  $\mathbb{C}^3$* , Math. Z. **214** (1993), 499–510.
159. ———, *Polynomials with general  $\mathbb{C}^2$ -fibers are variables*, Pacific J. Math. **203** (2002), 161–189.
160. ———, *Free  $\mathbb{C}^+$ -actions on  $\mathbb{C}^3$  are translations*, Invent. Math. **156** (2004), 163–173.
161. S. Kaliman, M. Koras, L. Makar-Limanov, and P. Russell,  *$\mathbb{C}^*$ -actions on  $\mathbb{C}^3$  are linearizable*, Electron. Res. Announc. Amer. Math. Soc. **3** (1997), 63–71.
162. S. Kaliman and L. Makar-Limanov, *AK-invariant of affine domains*, to appear in “Affine Algebraic Geometry”, Proceedings of the 2004 Conference to honor the retirement of M. Miyanishi.
163. ———, *On the Russell-Koras contractible threefolds*, J. Algebraic Geom. **6** (1997), 247–268.

164. S. Kaliman and N. Saveliev,  $\mathbb{C}^+$ -actions on contractible threefolds, Michigan Math. J. **52** (2004), 619–625.
165. S. Kaliman, S. Vénéreau, and M. Zaidenberg, Simple birational extensions of the polynomial ring  $\mathbb{C}^{[3]}$ , Trans. Amer. Math. Soc. **356** (2004), 509–555.
166. S. Kaliman and M. Zaidenberg, Miyanishi's characterization of the affine 3-space does not hold in higher dimensions, Ann. Inst. Fourier, Grenoble **50** (2000), 1649–1669.
167. ———, Vénéreau polynomials and related fiber bundles, J. Pure Applied Algebra **192** (2004), 275–286.
168. T. Kambayashi, Automorphism group of a polynomial ring and algebraic group action on an affine space, J. Algebra **60** (1979), 439–451.
169. J. Khoury, On some properties of elementary derivations in dimension six, J. Pure Appl. Algebra **156** (2001), 69–79.
170. A. W. Knap, *Lie Groups Beyond an Introduction*, Birkhäuser (Second Edition), 2002, Boston, Basel, Stuttgart.
171. H. Kojima and M. Miyanishi, On P. Roberts' counterexample to the fourteenth problem of Hilbert, J. Pure Appl. Algebra **122** (1997), 247–268.
172. M. Koras and P. Russell, Contractible threefolds and  $\mathbb{C}^*$ -actions on  $\mathbb{C}^3$ , J. Algebraic Geom. **6** (1997), 671–695.
173. ———,  $\mathbb{C}^*$ -actions on  $\mathbb{C}^3$ : The smooth locus of the quotient is not of hyperbolic type, J. Algebraic Geom. **8** (1999), 603–694.
174. H. Kraft, *Geometrische Methoden in der Invariantentheorie*, Vieweg-Verlag, 1985, Braunschweig.
175. ———, Challenging problems on affine  $n$ -space, Séminaire Bourbaki **802** (1995), 295–317.
176. ———, Free  $\mathbb{C}^+$ -actions on affine threefolds, Contemp. Math., vol. 369, pp. 165–175, American Mathematical Society, Providence, RI, 2005.
177. H. Kraft and C. Procesi, *Classical Invariant Theory: A Primer*, 1996, avail. at [www.math.unibas.ch](http://www.math.unibas.ch).
178. E. Kunz, *Introduction to Commutative Algebra and Algebraic Geometry*, Birkhäuser, 1985, Boston, Basel, Stuttgart.
179. K. Kurano, Positive characteristic finite generation of symbolic Rees algebra and Roberts' counterexamples to the fourteenth problem of Hilbert, Tokyo J. Math. **16** (1993), 473–496.
180. S. Kuroda, Hilbert's fourteenth problem and algebraic extensions, preprint 2006.
181. ———, Hilbert's fourteenth problem and invariant fields of finite groups, preprint 2006.
182. ———, A counterexample to the Fourteenth Problem of Hilbert in dimension four, J. Algebra **279** (2004), 126–134.
183. ———, A generalization of Roberts' counterexample to the Fourteenth Problem of Hilbert, Tohoku Math. J. **56** (2004), 501–522.
184. ———, A counterexample to the Fourteenth Problem of Hilbert in dimension three, Michigan Math. J. **53** (2005), 123–132.
185. ———, Fields defined by locally nilpotent derivations and monomials, J. Algebra **293** (2005), 395–406.
186. J. Kuttler and N. Wallach, Representations of  $SL_2$  and the distribution of points in  $\mathbb{P}^n$ , Prog. Math., vol. 220, pp. 355–373, Birkhäuser (Boston, Basel, Berlin), 2004, In: Noncommutative Harmonic Analysis.
187. J. Lipman, Free derivation modules on algebraic varieties, Amer. J. Math. **87** (1965), 874–898.



188. L. Makar-Limanov, *Abhyankar-Moh-Suzuki, new proof*, preprint 2004, 14 pages.
189. ———, *Facts about cancelation*, preprint 1997, 6 pages.
190. ———, *Locally nilpotent derivations, a new ring invariant and applications*, Lecture notes, Bar-Ilan University, 1998. Avail. at <http://www.math.wayne.edu/~lml/>.
191. ———, *Locally nilpotent derivations of affine domains*, MPIM Preprint Series 2004-92. Avail. at [www.mpim-bonn.mpg.de](http://www.mpim-bonn.mpg.de).
192. ———, *On the group of automorphisms of a class of surfaces*, Israel J. Math. **69** (1990), 250–256.
193. ———, *On the hypersurface  $x + x^2y + z^2 + t^3 = 0$  in  $\mathbb{C}^4$  or a  $\mathbb{C}^3$ -like threefold which is not  $\mathbb{C}^3$* , Israel J. Math. **96** (1996), 419–429.
194. ———, *AK invariant, some conjectures, examples and counterexamples*, Ann. Polon. Math. **76** (2001), 139–145.
195. ———, *On the group of automorphisms of a surface  $x^n y = p(z)$* , Israel J. Math. **121** (2001), 113–123.
196. ———, *Again  $x + x^2y + z^2 + t^3 = 0$* , Contemp. Math., vol. 369, pp. 177–182, American Mathematical Society, Providence, RI, 2005.
197. L. Makar-Limanov and A. Nowicki, *On the rings of constants for derivations of power series rings in two variables*, Colloq. Math. **87** (2001), 195–200.
198. L. Makar-Limanov, P. van Rossum, V. Shpilrain, and J.-T. Yu, *The stable equivalence and cancellation problems*, Comment. Math. Helv. **79** (2004), 341–349.
199. K. Masuda, *Torus actions and kernels of locally nilpotent derivations with slices*, preprint 2005, 10 pages.
200. K. Masuda and M. Miyanishi, *The additive group actions on  $\mathbb{Q}$ -homology planes*, Ann. Inst. Fourier (Grenoble) **53** (2003), 429–464.
201. S. Maubach, *Hilbert 14 and related subjects*, Master’s thesis, Catholic Univ. Nijmegen, 1998.
202. ———, *Triangular monomial derivations on  $k[x_1, x_2, x_3, x_4]$  have kernel generated by at most four elements*, J. Pure Appl. Algebra **153** (2000), 165–170.
203. ———, *An algorithm to compute the kernel of a derivation up to a certain degree*, Ann. Polon. Math. **76** (2001), 147–158.
204. ———, *The commuting derivations conjecture*, J. Pure Appl. Algebra **179** (2003), 159–168.
205. ———, *Polynomial endomorphisms and kernels of derivations*, Ph.D. thesis, Univ. Nijmegen, The Netherlands, 2003.
206. L. Maurer, *Über die Endlichkeit der Invariantensysteme*, Sitzungsber. Math.-Phys. Kl. Kgl. Bayer. Akad. Wiss. München **29** (1899), 147–175.
207. J. H. McKay and S. Wang, *An elementary proof of the automorphism theorem for the polynomial ring in two variables*, J. Pure Appl. Algebra **52** (1988), 91–102.
208. M. Miyanishi, *Recent developments in affine algebraic geometry: (From the personal viewpoints of the author)*, preprint, 67 pages.
209. ———, *A remark on an iterative infinite higher derivation*, J. Math. Kyoto Univ. **8** (1968), 411–415.
210. ———,  *$\mathbb{G}_a$ -action of the affine plane*, Nagoya Math. J. **41** (1971), 97–100.
211. ———, *Some remarks on polynomial rings*, Osaka J. Math. **10** (1973), 617–624.
212. ———, *Algebraic characterization of the affine plane*, J. Math. Kyoto Univ. **15** (1975), 169–184.

213. ———, *Lectures on Curves on Rational and Unirational Surfaces*, Springer-Verlag (Berlin, Heidelberg, New York), 1978, Published for Tata Inst. Fund. Res., Bombay.
214. ———, *Regular subring of a polynomial ring*, Osaka J. Math. **17** (1980), 329–338.
215. ———, *Non-complete algebraic surfaces*, Springer-Verlag (Berlin, Heidelberg, New York), 1981.
216. ———, *An algebro-topological characterization of the affine space of dimension three*, Amer. J. Math. **106** (1984), 1469–1486.
217. ———, *Normal affine subalgebras of a polynomial ring*, Algebraic and Topological Theories—to the memory of Dr. Takehiko Miyata (Tokyo), Kinokuniya, 1985, pp. 37–51.
218. ———, *Algebraic characterizations of the affine 3-space*, Proc. Algebraic Geom. Seminar, Singapore, World Scientific, 1987, pp. 1469–1486.
219. ———, *Algebraic geometry*, Translations of Math. Monographs, vol. 136, American Mathematical Society, Providence, 1990.
220. ———, *Vector fields on factorial schemes*, J. Algebra **173** (1995), 144–165.
221. ———, *Open algebraic surfaces*, CRM Monograph Series, vol. 12, American Mathematical Society, 2000.
222. M. Miyanishi and T. Sugie, *Affine surfaces containing cylinderlike open sets*, J. Math. Kyoto U. **20** (1980), 11–42.
223. ———, *On a projective plane curve whose complement has logarithmic Kodaira dimension  $-\infty$* , Osaka J. Math. **18** (1981), 1–11.
224. ———, *Homology planes with quotient singularities*, J. Math. Kyoto U. **31** (1991), 755–788.
225. M. Miyanishi and S. Tsunoda, *Non-complete algebraic surfaces with logarithmic Kodaira dimension  $-\infty$  and with non-connected boundaries at infinity*, Japan J. Math. **10** (1984), 195–242.
226. ———, *Open algebraic surfaces with logarithmic Kodaira dimension  $-\infty$  and logarithmic del Pezzo surfaces of rank 1*, Proc. Symp. Pure Math. **46** (1987), 435–450.
227. S. Mukai, *Counterexample to Hilbert’s fourteenth problem for the 3-dimensional additive group*, RIMS Preprint 1343, Kyoto, 2001.
228. ———, *Finite and infinite generation of Nagata invariant ring*, Talk abstract, Oberwolfach, 2004. Avail. at [www.kurims.kyoto-u.ac.jp/~mukai/paper/Oberwolfach04.pdf](http://www.kurims.kyoto-u.ac.jp/~mukai/paper/Oberwolfach04.pdf).
229. ———, *Finite generation of the Nagata invariant rings in A-D-E cases*, preprint 2005, to appear.
230. ———, *Geometric realization of T-shaped root systems and counterexamples to Hilbert’s fourteenth problem*, Algebraic Transformation Groups and Algebraic Varieties, 123–129, Springer-Verlag, Berlin, 2004, Encyclopaedia Math. Sci. 132.
231. S. Mukai and H. Naito, *On some invariant rings for the two dimensional additive group action*, avail. at <http://www.eprints.math.sci.hokudai.ac.jp>.
232. D. Mumford, *Abelian Varieties*, Oxford Univ. Press (Oxford, UK), 1970.
233. ———, *Hilbert’s fourteenth problem—the finite generation of subrings such as rings of invariants*, Proc. Symp. Pure Math. 28 (Providence), Amer. Math. Soc., 1976, pp. 431–444.

234. D. Mumford and J. Fogarty, *Geometric Invariant Theory (Third enlarged edition)*, Ergebnisse der Mathematik und ihrer Grenzgebiete, vol. 34, Springer-Verlag, 1994.
235. M. Nagata, *On the 14-th Problem of Hilbert*, Amer. J. Math. **81** (1959), 766–772.
236. ———, *On the Fourteenth Problem of Hilbert*, Proc. I.C.M. 1958, Cambridge University Press, 1960, pp. 459–462.
237. ———, *Note on orbit spaces*, Osaka J. Math. **14** (1962), 21–31.
238. ———, *Lectures on the Fourteenth Problem of Hilbert*, Lecture Notes, vol. 31, Tata Inst., Bombay, 1965.
239. ———, *On Automorphism Group of  $k[x, y]$* , Lectures in Math. Kyoto Univ., vol. 5, Kinokuniya Bookstore, Tokyo, 1972.
240. ———, *Polynomial Rings and Affine Spaces*, CBMS Regional Conference Series in Mathematics, vol. 37, American Mathematical Society, Providence, Rhode Island, 1978.
241. M. Nagata and A. Nowicki, *Rings of constants for  $k$ -derivations in  $k[x_1, \dots, x_n]$* , J. Math. Kyoto Univ. **28** (1988), 111–118.
242. P. E. Newstead, *Introduction to Moduli Problems and Orbit Spaces*, Tata Institute, Bombay, 1978.
243. E. Noether, *Der Endlichkeitssatz der Invarianten enlicher Gruppen*, Math. Ann. **77** (1916), 89–92.
244. ———, *Der Endlichkeitssatz der Invarianten enlicher linearer Gruppen der Charakteristik  $p$* , Nachr. Ges. Wiss. Göttingen (1926), 28–35.
245. D. G. Northcott, *Affine Sets and Affine Groups*, London Math. Society Lecture Note Series, vol. 39, Cambridge University Press, Cambridge, UK, 1980.
246. P. Nousiainen and M. Sweedler, *Automorphisms of polynomial and power series rings*, J. Pure Appl. Algebra **29** (1983), 93–97.
247. A. Nowicki, *Polynomial Derivations and their Rings of Constants*, Uniwersytet Mikolaja Kopernika, Toruń, 1994.
248. ———, *Rings and fields of constants for derivations in characteristic zero*, J. Pure Appl. Algebra **96** (1994), 47–55.
249. N. Onoda, *Linear  $\mathbb{G}_a$ -actions on polynomial rings*, Proceedings of the 25th Symposium on Ring Theory (Okayama, Japan) (Y. Tsushima and Y. Watanabe, eds.), 1992, pp. 11–16.
250. K. Pommerening, *Invariants of unipotent groups: A survey*, Invariant Theory (New York), Lectures Notes in Math., vol. 1278, Springer-Verlag, 1987, pp. 8–17.
251. V. L. Popov, *Hilbert's theorem on invariants*, Soviet Math. Dokl. **20** (1979), 1318–1322.
252. ———, *Contraction of the actions of reductive algebraic groups*, Math. USSR-Sb. **58** (1987), 311–335.
253. ———, *On actions of  $\mathbb{G}_a$  on  $\mathbb{A}^n$* , Algebraic Groups, Utrecht 1986 (New York), Lectures Notes in Math., vol. 1271, Springer-Verlag, 1987, pp. 237–242.
254. ———, *Groups, Generators, Syzygies, and Orbits in Invariant Theory*, Translations of Math. Monographs, vol. 100, Amer. Math. Soc., Providence, 1992.
255. ———, *On polynomial automorphisms of affine spaces*, Izv. Math. **65** (2001), 569–587.
256. D. Quillen, *Projective modules over polynomial rings*, Invent. Math. **36** (1976), 167–171.

257. G. Kemper R. Bryant, *Global degree bounds and the transfer principle for invariants*, J. Algebra **284** (2005), 80–90.
258. C. P. Ramanujam, *A topological characterization of the affine plane as an algebraic variety*, Ann. of Math. **94** (1971), 69–88.
259. D. Rees, *On a problem of Zariski*, Illinois J. Math. **2** (1958), 145–149.
260. R. Rentschler, *Opérations du groupe additif sur le plan affine*, C. R. Acad. Sc. Paris **267** (1968), 384–387.
261. M. Roberts, *On the covariants of a binary quantic of the  $n$ th degree*, Quart. J. Pure Appl. Math. **4** (1861), 168–178.
262. P. Roberts, *A prime ideal in a polynomial ring whose symbolic blow-up is not noetherian*, Proc. Amer. Math. Soc. **94** (1985), 589–592.
263. ———, *An infinitely generated symbolic blow-up in a power series ring and a new counterexample to Hilbert’s fourteenth problem*, J. Algebra **132** (1990), 461–473.
264. J. Roé, *On the existence of plane curves with imposed multiple points*, J. Pure Appl. Algebra **156** (2001), 115–126.
265. M. Rosenlicht, *On quotient varieties and the affine embedding of certain homogeneous spaces*, Trans. Amer. Math. Soc. **101** (1961), 211–223.
266. K.P. Russell, *Simple birational extensions of two dimensional affine rational domains*, Compositio Math. **33** (1976), 197–208.
267. ———, *On Affine-Ruled Rational Surfaces*, Math. Annalen **255** (1981), 287–302.
268. C. S. de Salas, *Invariant theory for unipotent groups and an algorithm for computing invariants*, Proc. London Math. Soc. **81** (1999), 387–404.
269. A. Sathaye, *An application of generalized Newton Puiseux expansions to a conjecture of D. Daigle and G. Freudenburg*, Algebra, Arithmetic and Geometry with Applications (West Lafayette, IN, 2000), Springer Verlag, 2004, pp. 687–701.
270. J. Schröer, *Varieties of pairs of nilpotent matrices annihilating each other*, Comment. Math. Helv. **79** (2004), 396–426.
271. G. Schwarz, *Book review: Groups, generators, syzygies, and orbits in invariant theory, by V.L. Popov*, Bull. Amer. Math. Soc. **29** (1993), 299–304.
272. A. Seidenberg, *Derivations and integral closure*, Pacific J. Math. **16** (1966), 167–173.
273. J. P. Serre, *A course in arithmetic*, Springer-Verlag (Berlin, Heidelberg, New York), 1973.
274. ———, *Trees*, Springer-Verlag (Berlin, Heidelberg, New York), 1980.
275. C. S. Seshadri, *On a theorem of Weitzenböck in invariant theory*, J. Math. Kyoto Univ. **1** (1962), 403–409.
276. I. R. Shafarevich, *On some infinite dimensional groups*, Rend. Mat. Appl. (5) **25** (1966), 208–212.
277. A. R. Shastri, *Polynomial representations of knots*, Tôhoku Math. J. **44** (1992), 11–17.
278. I. P. Shestakov and U. U. Umirbaev, *Poisson brackets and two-generated subalgebras of ring of polynomials*, J. Amer. Math. Soc. **17** (2004), 181–196.
279. ———, *The tame and the wild automorphisms of polynomial rings in three variables*, J. Amer. Math. Soc. **17** (2004), 197–227.
280. T. Siebert, *Lie algebras of derivations and affine algebraic geometry over fields of characteristic 0*, Math. Ann. **305** (1996), 271–286.

281. M. K. Smith, *Stably tame automorphisms*, J. Pure Appl. Algebra **58** (1989), 209–212.
282. D. M. Snow, *Triangular actions on  $\mathbb{C}^3$* , Manuscripta Mathematica **60** (1988), 407–415.
283. ———, *Unipotent actions on affine space*, Topological Methods in Algebraic Transformation Groups, Progress in Mathematics, vol. 80, Birkhäuser, 1989, pp. 165–176.
284. V. Srinivas, *On the embedding dimension of an affine variety*, Math. Ann. **289** (1991), 125–132.
285. Y. Stein, *On the density of image of differential operators generated by polynomials*, J. Analyse Math. **52** (1989), 291–300.
286. R. Steinberg, *Nagata's example*, Algebraic Groups and Lie Groups, Cambridge University Press, 1997, pp. 375–384.
287. T. Sugie, *Algebraic characterization of the affine plane and the affine 3-space*, Topological Methods in Algebraic Transformation Groups, Progress in Mathematics, vol. 80, Birkhäuser, 1989, pp. 177–190.
288. A. Suslin, *Projective modules over a polynomial ring*, Soviet Math. Doklady **17** (1976), 1160–1164.
289. M. Suzuki, *Propriétés topologiques des polynômes de deux variables complexes, et automorphismes algébriques de l'espace  $\mathbb{C}^2$* , J. Math. Soc. Japan **26** (1974), 241–257.
290. R. G. Swan, *Algebraic Geometry Seminar lecture notes*, University of Chicago, 1979 (unpublished).
291. L. Tan, *An algorithm for explicit generators of the invariants of the basic  $\mathbb{G}_a$ -actions*, Comm. Algebra **17** (1989), 565–572.
292. R. Tanimoto, *A note on Hilbert's Fourteenth Problem for monomial derivations*, to appear in “Affine Algebraic Geometry”, Proceedings of the 2004 Conference to honor the retirement of M. Miyanishi.
293. ———, *On Freudenburg's counterexample to the Fourteenth Problem of Hilbert*, preprint 2004, 32 pages.
294. ———, *Rings of invariants of  $\mathbb{G}_a$  acting linearly on polynomial rings*, preprint 2005.
295. ———, *Linear counterexamples to the fourteenth problem of Hilbert*, J. Algebra **275** (2004), 331–338.
296. G. M. Tuynman, *The derivation of the exponential map of matrices*, Amer. Math. Monthly **102** (1995), 818–820.
297. Andrzej Tyc, *An elementary proof of the Weitzenböck theorem*, Colloq. Math. **78** (1998), 123–132.
298. W. van der Kulk, *On polynomial rings in two variables*, Nieuw Arch. Wisk. **1** (1953), 33–41.
299. P. van Rossum, *Tackling problems on affine space with locally nilpotent derivations on polynomial rings*, Ph.D. thesis, Univ. Nijmegen, The Netherlands, 2001.
300. W. V. Vasconcelos, *Derivations of Commutative Noetherian Rings*, Math Z. **112** (1969), 229–233.
301. S. Vénéreau, *Automorphismes et variables de l'anneau de polynômes  $A[y_1, \dots, y_n]$* , Ph.D. thesis, Institut Fourier des mathématiques, Grenoble, 2001.
302. Z. Wang, *Locally Nilpotent Derivations of Polynomial Rings*, Ph.D. thesis, Univ. Ottawa, 1999.

303. ———, *Homogeneization of locally nilpotent derivations and an application to  $k[x, y, z]$* , J. Pure Appl. Algebra **196** (2005), 323–337.
304. R. Weitzenböck, *Über die Invarianten von linearen Gruppen*, Acta Math. **58** (1932), 231–293.
305. J. Wilkens, *On the cancellation problem for surfaces*, C. R. Acad. Sci. Paris Sér. I Math. **326** (1998), 1111–1116.
306. J. Winkelmann, *On free holomorphic  $\mathbb{C}$ -actions on  $\mathbb{C}^n$  and homogeneous Stein manifolds*, Math. Ann. **286** (1990), 593–612.
307. ———, *Invariant rings and quas affine quotients*, Math. Z. **244** (2003), 163–174.
308. D. L. Wright, *Algebras which resemble symmetric algebras*, Ph.D. thesis, Columbia University, New York, 1975.
309. ———, *The amalgamated free product structure of  $GL_2(k[X_1, \dots, X_n])$  and the weak jacobian theorem for two variables*, J. Pure Appl. Algebra **12** (1978), 235–251.
310. ———, *Abelian subgroups of  $Aut_k(k[x, y])$  and applications to actions on the affine plane*, Illinois J. Math. **23** (1979), 579–634.
311. ———, *On the Jacobian Conjecture*, Illinois J. of Math. **25** (1981), 423–440.
312. ———, *Two-dimensional Cremona groups acting on simplicial complexes*, Trans. Amer. Math. Soc. **331** (1992), 281–300.
313. H. Yoshihara, *On plane rational curves*, Proc. Japan Acad. (Ser. A) **55** (1979), 152–155.
314. O. Zariski, *Interpretations algebrico-geometriques du quatorzieme problem de Hilbert*, Bull. Sci. Math. **78** (1954), 155–168.
315. V.D. Zurkowski, *Locally finite derivations*, preprint, 26 pages.
316. ———, *Locally finite derivations in dimension three*, preprint, 76 pages.

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